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Understanding Cyberspace Cartographies: A Critical Analysis of Internet Infrastructure Mapping

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Declaration

I, Martin Dodge, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Signed: _

Date: ___

Abstract

For thousands of years, people have been creating maps of the world around them as a means of understanding, navigating and controlling space. Cyberspace is the pre-eminent *terra incognita* of the twenty-first century and a wide range of maps and map-like visualisations have been produced to comprehend it. Many different aspects of cyberspace have been mapped, from the physical infrastructure, the data flows and customer statistics, to the emergent patterns of Web hyperlinks and the social structures of online forums. This thesis provides a discussion of the nature of these maps and visualisations, recognising them as complex socio-technical visual images open to multiple connotative interpretation, and imbued with political power and embedded in a wider socio-cultural milieu. The work is situated theoretically within contemporary cultural analyses of cartography, employing a hermeneutic epistemology and a non-progressive categorisation of cyberspace mapmaking practices into distinct, but overlapping and contested modes. The research questions tackled by the thesis are threefold, involving auditing how Internet infrastructures have been mapped, how these maps work semiotically and what is the nature of power they have to do work in the world.

The thesis is an empirically-focused interpretative approach applied to an important mode of cyberspace cartographies: those that map Internet infrastructures. These maps give a fascinating picture of what the Internet looks like, and, significantly, they also provide rich insights into how different interest groups want the Internet to look. The goal of the analysis is to understand both the design connotations of the cartographic signs and the political imaginings of maps of the Internet infrastructure and this proceeds via two detailed case studies. The first case study focuses on the connotative meaning and power of statistical mapping to represent the nature of the globalisation of Internet connectivity. The second case study critiques marketing maps that sell infrastructure access and are intimately bound up in promoting the notion of global network reach.

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Chapter One

Introduction

> Now when I was a little chap I had a passion for maps. I would look for hours at South America, or Africa, or Australia, and lose myself in all the glories of exploration. At that time there were many blank spaces on the earth and when I found one that looked particularly inviting on a map (but they all look that) I would put my finger on it and say, 'When I grow up I will go there'.
>
> -- Joseph Conrad, *Heart of Darkness*, 1902.

> I want to investigate in what ways this cartographic imaginary proliferates spaces and the ways in which we can live in them.
>
> -- John Pickles, *A History of Spaces*, 2004.

1.1 Aims

This thesis is one of the outcomes of an ongoing, ten-year long, cybergeography research project focused on describing the various socio-spatial forms of cyberspace, analysing their supporting material infrastructures and understanding their implications for the geographical organisation of everyday living. The epistemological and philosophical approach I have taken is centred around the map as a process of knowledge construction and as social-material site for critique. The goal of the thesis is to provide an analysis of the semiotic meanings and political 'imaginings' of cyberspace cartographies through a critical reading of maps of Internet network infrastructures.

To understand the power of maps, particularly in contemporary Western capitalist contexts, one must grasp how they stir both the imagination and work instrumentally in the exploration and exploitation of new spaces. As Joseph Conrad's narrator Marlow makes clear in the *Heart of Darkness*, mapped representations open up space to the imagination. This cartographic imaginary, according to theorist John Pickles, is more than looking, it inspires action, it beckons space into being and needs to be understood in relationship to living within and through cyberspace[1].

Cyberspace is often portrayed as the pre-eminent 'blank' space of the twenty-first century, an alluring virtual *terra incognita.* The fact that its digitally-mediated territories are composed of software code rather than vast deserts or impenetrable jungle does not weaken the desire for exploration or the potency of the cartographic imaginary in representing it in particular ways for competing interests. Cyberspace cartographies are opening up unique ways to visually understand the complex, multivalent and intangible nature of virtual spaces. Yet, just like in the *Heart of Darkness,* the opening up of cyberspace through particular cartographic gazes also closes down some avenues of development and some of the latent potential of virtual space at the same time. A mapped space becomes a known place, a controllable territory that can be more effectively used by certain interests and groups over and above others.

Many different aspects of cyberspace have been mapped, ranging from the physical infrastructure, the logical layers of data links, the routing details held in software code, traffic flows, customer statistics, hyperlink structures of the Web, the emergent patterns of social interaction, along with new interactive spatialisations[2] to navigate in the myriad of online forums and information resources (see Dodge 2005 for examples). The maps cover a range of different scales from individual local area networks and single websites up to global scale visualisation of vast topological grids and the graphical exploration of the online social networks of millions of people. Some of the maps and spatialisations adhere to established conventions of cartographic design, but many more use different visual vocabularies. A few are beautiful and many more are really

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[1] As pointed out by C. Board (viva, October 2006) Pickles' notion is in many ways a subset of a more general 'geographical imaginary', that is particular historically continent ways of seeing and thinking about places and social groups that, while they are subjective and stereotypical, actually affect how decisions are made. (cf. Gregory 1994). Maps are potent means for creating such imagined and preconceived notions of place and people (cf. Schulten 2001).

[2] Spatialisations are a form of visualisation where a spatial structure and map-like interface is applied to data where no inherent or obvious geographical one exists. They are used to provide an interpretable, navigable structure to various types of non-geographic datasets, particularly large text corpuses (cf. Couclelis 1998; Dodge and Kitchin 2000a; Skupin and Fabrikant 2003).

rather unappealing in terms of quality of design and aesthetics. A few are quite useful as practical cartographic tools for navigating new virtual space, but many more are not effective at all for route following or finding particular sites. However, all the maps provide a fascinatingly diverse picture of what cyberspace looks like, and they can also be read connotatively and interpreted politically to provide valuable insights into how people *imagine* the virtual territory to look in service to their interests and desires. Understanding the connotative meanings and political contexts of cartographies of cyberspace is, therefore, important because they not only reflect the nature of the virtual world according to the interests of map-makers and mapping institutions, but also because they play a fundamental role in shaping the ongoing social-material (re)production of those virtual spaces. They are active in the producing a cartographic imaginary of cyberspace but also in producing cyberspace itself.

This new and diverse emerging domain of cyberspace mapping activities can be usefully conceptualised, following Edney (1993), into three distinct cartographic modes. The first mode, what I term, 'maps <u>of</u> cyberspace' is mapping which describes the material information and communications technology (ICT) infrastructures and documents the operations of cyberspace itself, as viewed from an external position. (This thesis is focused on this mode through the analysis of Internet infrastructure maps.) In some senses they can be thought of as the thematic maps of cyberspace and are distinct from the other two modes. 'Maps <u>for</u> cyberspace', the second mode, are maps and spatialisations created for navigating within cyberspace; they are expressly designed to be used to 'interface' virtual spaces themselves. The final mode, 'maps <u>in</u> cyberspace' involves putting existing forms of terrestrial mapping online to widen access and add user interactivity. This mode is far and away the most evident in terms of the many millions of people using online services like MapQuest and Google Earth. (These three mode conceptualisation is discussed further in chapter three.)

1.2 Research questions

The major research questions tackled by the thesis are threefold:

1. What are the main ways that Internet infrastructures have been mapped?
2. How do the elements of cartographic design in terms denotative signs on these maps work in creating particular kinds of connotative meanings about the Internet infrastructures?
3. Within what kind of culture milieus and political contexts are these maps of Internet infrastructures embedded and how does this effect the power they exert in advancing particular interests and agendas?

A range of relevant empirical evidence to answer these questions has been gathered, primary from texts published online and from corporate reports and government documents. The primary cartographic evidence is analysed utilising three methodological approaches: (1) processes of audit and classification, (2) semiotic interpretation of connotative meanings of representations and (3) a deconstructive reading of the maps.

1.2 Defining themes

> Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts...A graphical representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding... (Gibson 1984, 67.)

1.2.1 Cyberspace

Historically considered, cyberspace emerged from the convergence of two sets of technologies: those for the transmission of information and those for the automation of computation. (This convergence is itself premised on the fundamental digitisation of the operations and products of both of these sets of technologies.) Since the second world war the technologies of computing and telecommunication have grown dramatically in capacity and fallen in per unit cost. As is well noted, they have diffused throughout society and have had a significant transformative agency in the nature of everyday living (Castells

1996), including radically altering space-time relations in complex ways through processes of space-time convergence, time-space compression, and distanciation of service provision (Janelle 1969; Harvey 1989; Giddens 1990). They also give rise to cyberspaces, the conceptual spaces of information flows and social interactions that are continually created *within* the infrastructural ensemble of digital computing hardware, software code and high-speed telecommunications networks.

Cyberspace is not the technology or infrastructure itself (although it cannot exist independently of these), but the *experience* of virtual spaces that these engender. The word literally means 'navigable space' and is derived from the Greek word *kyber* (to navigate). As a description of virtual space it was conceived by William Gibson, in his novel *Neuromancer* (1984, 51), as a three-dimensional 'data-scape' inside the global matrix of computer networks where disembodied users interact with "clusters and constellations of data". As an everyday human phenomena, cyberspace is much more mundane than Gibson's science-fiction imaginary, but is fast becoming as powerful in mediating social relationships and re-shaping the material world. For example, cyberspace "is the 'place' where a telephone conversation appears to occur. Not inside your actual phone, the plastic device on your desk. Not inside the other person's phone, in some other city. The place between the phones. The indefinite place out there, where the two of you, two human beings, actually meet and communicate" (Sterling 1992, 1). Cyberspace is also the 'space' where your money is (to paraphrase John Perry Barlow[3]) and is fast becoming the primary archive of many of personal memories (through online diaries and blogs, emails and text messages, digital photographs, and so on). The Internet is most obvious element of cyberspace currently in Western societies, but it is only one particular socio-technical instance amongst many (albeit a very rapidly growing, complex and heterogeneous one).

Cyberspaces are not 'real' in terms of common-sense definitions of material 'stuff' you can touch; they are, in Gibson's phrase, a 'consensual hallucination' created by software code and visual interfaces, and made tangible by access

[3] Cited in Rheingold 1993, 68.

devices (screens, keyboards, speakers, mice, joysticks, and so on). However, they are perceived as real places in that they can have very real, material consequences (e.g., money being stolen electronically from a bank account). This is because cyberspace is folded into everyday lived experience more and more, rather than being some exotic, dissociated paraspace[4] (as it was frequently depicted cinematically in the 1990s). Uses of ICTs are themselves embodied and the experiences of virtual spaces form a complex continuum from purely material spaces to wholly cyberspaces, with many social activities now taking place on the thresholds between the "virtually real and the actually real" (Madge and O'Connor 2005, 83). An illustration of this experiential continuum is the extent to which cyberspace explicitly draws on material socio-spatial relations and geographic metaphors to create new spatialities and a sense of place (see also chapter four discussions on role of metaphors to explain the nature of the Internet).

[4] Paraspace means 'other space' - a sublime space that has forms and practices alien to that in geographic space (see Bingham 1999).

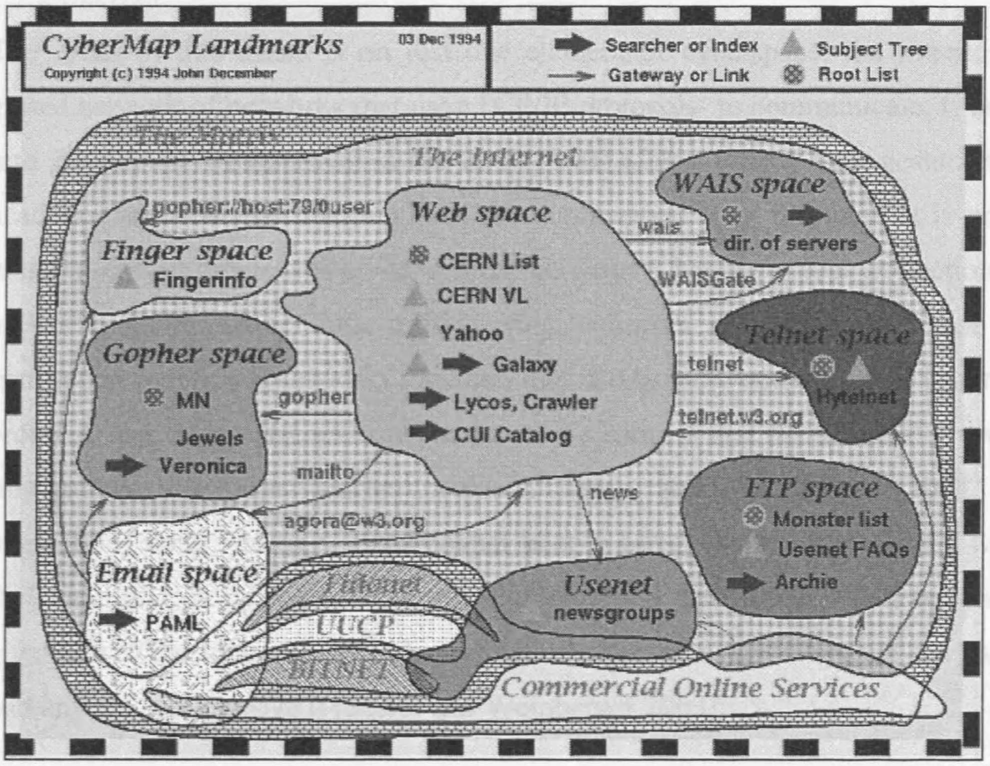

Figure 1.1: An attempt to sketch the principal online virtual spaces of cyberspace, circa 1994. While it is now out of date factually, the map is still useful for the way it conceptualises cyberspace as multiple, irregularly-sized domains with fluid boundaries, and many interconnections and overlaps. (Source: December 1995, no pagination.)

Given the bleeding together of real and virtual activities, cyberspaces are always contingent on the time and place of their production. Typically, they are heterogeneous in structure and fast changing. There are a rapidly expanding range of online virtual spaces experienced through different forms of interaction and communication affordances (Figure 1.1). There is also convergence of technologies that allows new spaces to emerge (such as the rapid growth in text messaging on mobile phones, or the emergence of voice over Internet protocol telephony services). Reliable, representative and comparative statistics on the scope and structure of cyberspace are notoriously hard to gather and quickly become obsolete. All these characteristics mean it is challenging space to survey and has served as a driver in the development of new techniques of mapping.

1.2.2 Internet

The focus of this thesis is on just one element of cyberspace, the Internet, a global network of networks that uses TCP/IP protocols[5] to communicate. It burst into the popular imagination in the early 1990s after a twenty year gestation in academic and research communities. At a conceptual level the Internet is not a material entity, rather it is an agreement between a heterogeneous collection of networks to exchange data traffic using common protocols. The ease of connecting individual networks together, that is inter-networking, via IP (internet protocol) has been paramount to the Internet's success and phenomenal growth. Importantly, the core Internet protocol, Searls and Weinberger (2003, no pagination) note, "doesn't specify what people can do with the network, what they can build on its edges, what they can say, who gets to talk". This openness gives rise to the Internet's three key virtues: no one owns its, everyone can use it and anyone can improve it (Searls and Weinberger 2003).

Anyone with a computer, a modem and a telephone can connect to one of the networks and, through it, to the rest of the public Internet[6]. (Note, there are many private intranets which also use the same TCP/IP protocols but are not interconnected to the public Internet.) The sum of the Internet's nodes and their connections is greater than their parts, forming a network of network that empowers millions of people to directly communicate and share information with each other for the first time in human history.

Built around this agreement is a vast socio-material infrastructure to move data and to provide services. The physical construction of the Internet ranges from individual PCs connected via modems, to small domestic LANs up to immense networked assemblages such as undersea cable systems linking continents that cost billions to construct and require specialised ships to maintain them in working order. Given its open architecture no one knows for sure quite how

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[5] TCP/IP - Transmission Control Protocol / Internet Protocol.

[6] Various 'digital divide' issues exist, notwithstanding, relating to the unequal distribution of the Internet access and production (e.g., Warf 2001); for example, the cost of access, particularly telephone charges, vary markedly between countries (e.g., Petrazzini and Kibati 1999) along with the freedom to communicate without state censorship (e.g., Reporters without Borders 2003 analysis of Internet surveillance). See wider discussion in chapter five.

much infrastructure is enrolled in the ongoing production of the Internet, but it is significant. In January 2008, for example, there were some 541,677,000 hosts on the Internet according to one of the most creditable 'hardware' statistics[7], an increase of 20% from January 2007.

The development of the Internet has not been achieved independently and is bound up in the histories of telecommunication technologies, computing and wider social and political-economic histories of media (including easily overlooked and banal infrastructures, such as the ASCII text encoding format). The contemporary Internet is the outcome of a specific set of political-economic relations, most especially to do with the Cold War funding for computing research; the Internet has a particular historical geography that centres it in the U.S., and early Internet development was guided by the military-industrial-academic complex (cf. Abbate 1999). It was only later that it became re-appropriated into the public and commercial domain.

The Internet itself is experienced as a variety of different virtual spaces and media channels that are built seamlessly on top of it, including email, instant-messaging, peer-to-peer file sharing, and, of course, the Web. As Castells (2001, 269) rightly points out, the Internet is more than just the sum of its infrastructural parts; "it is the technological tool and organisational form that distributes: information power, knowledge generation, and networking capacity in all realms of activity." It should be viewed as a general purpose technology, much like steam power and electrical current, in that it sets no preconditions on how it is used. As such, the Internet forms the vital motive force for ongoing processes of economic and cultural globalisation. The Internet is the cardinal infrastructure of the network society (Castells 1996).

1.2.3 Infrastructures

Conceptually, everything that works in the background necessary to effect a certain action or event is infrastructure. Infrastructures work transparently and

[7] The Internet Domain Name Survey, a biannual survey by Network Wizards, <www.isc.org>. A host is an Internet computer assigned a fix domain name, typically they are servers and routers which are permanently networked. The survey does not attempt to count the many hundreds of millions more PCs and computing devices that users connect to the Internet at various times.

have innate tendencies to disappear from consciousness (except, of course, when they fail). Multiple infrastructures mesh together into complex assemblages (e.g., air transportation); new infrastructures are often built onto of existing ones (e.g., fibre-optic cables running through old steam pipes). New infrastructures can emerge rapidly, but then quickly become naturalised and taken-for-granted in the everyday landscape of consumption (mobile telephony for example). Many infrastructures, particularly utility networks, are largely hidden from view being conveyed underground and in unseen service spaces of buildings; further the production of the infrastructural services are often far removed from the point of their consumption (especially so with growth of global supply chains). "[U]sers tended not to worry where the electrons that power their electricity came from; how their telephone conversations (or later faxes and Internet messages) were flitted across the city or the planet; how complex technological systems sustained their journey to work; or what distant gas and water reserves they were utilizing in their homes" (Graham 2000, 184). In the context of affluent Western consumer societies it is easy to assume that some infrastructures, increasingly including the Internet, are geographically ubiquitous and socially universal; while the conveniences they bring become viewed as *necessary* to living.

Given these characteristics, infrastructures, including Internet networks, tend not to be studied sufficiently within the social sciences (except for policy studies focused largely on their regulation). Studying infrastructures academically is made harder because they are often deliberately 'black-boxed' to keep outsiders from observing (and questioning) their operational logics. (It could be argued such external ignorance of the internal workings of network infrastructures usually serves the interests of the organisations operating them.) Although they can easily appear 'natural', infrastructures are anything but. They are designed and operated in particular ways (e.g., universal service versus cherry-picking through differential pricing), they have politics. Internet network infrastructures, connecting places together at various scales to facilitate efficient data transmission, are no different; they are bound up in wider sets of power relations.

One productive route into the study of infrastructures and their politics, I would argue, is through map representations of them. Maps of Internet network infrastructures reveal something of the nature of Internet itself (such as differential ownership patterns and the unevenness of the places served), but more than this they also reveal how the Internet is being conceptualised by the organisation behind the map. Maps then can make the Internet's politics visible for scholarly analysis because they ineluctably make the agenda of the map-makers visible.

1.2.4 Mapping

> And this, essentially is what maps give us, *reality*, a reality that exceeds our vision, our reach, the span of our days, a reality we achieve no other way. We are always mapping the invisible or the unattainable or the erasable, the future or the past, the whatever-is-not-here-present-to-our-senses-now and, through the gift that the map gives us, transmuting it into everything it is not ... *into the real.* (Wood 1992, 4-5)

In this research I take a broad view of what constitutes 'mapping'. Following Harley and Woodward (1987, xvi), I define it as the application of any graphic representation to facilitate a spatial understanding of things, concepts, conditions, processes, or events in the human world. The development of cartographic modes over millennia have provided in the Western cultural context uniquely powerful means by which to classify, represent and communicate information about areas that are too large and too complex to be seen directly. Well designed maps are relatively easy-to-interpret within their own socio-cultural milieu, and constitute concentrated repositories of information about the location, shape and size of key features of a landscape and the connections between them. More recently, it has been recognised that the process of spatialisation can provide an interpretable structure to other types of non-geographic data. In essence, maps and spatialisations exploit the mind's ability to more readily see complex relationships in images, providing a clear understanding of a phenomena, reducing search time, and revealing relationships that may otherwise not have been noticed. As a consequence, they form an integral part of how people understand and explain the world.

It is now widely recognised that mapping is a process of creating, rather than revealing, spatial knowledge. This applies to cyberspace cartographies as well.

Throughout the process of map creation a large number of subjective, often unconscious, decisions are made about what to include and what to exclude, how the map will look, and what message the map-maker is seeking to communicate. In this fashion, maps necessarily become imbued with the social norms and cultural values of the people who construct them. Commonly these norms and values reflect dominant power relations in the society, especially because individuals and institutions with power commission a great deal of cartographic production.

Maps are used in diverse ways by diverse audiences as the work that maps perform is contingent on the times and places in which they are consumed. Maps are situated and selective re-presentations of spatial knowledges. They are not objective, neutral artefacts, but a view point onto the world from a particular perspective. This thesis is concerned with understanding the nature of these view points and perspectives into cyberspace revealed through case studies of how and why Internet infrastructures have been mapped.

1.3 Theoretical approach

The research undertaken on the cartographies of cyberspace, their design, authorship, dissemination and circulation, draws theoretically on concepts from two domains: semiotics of map design and critical cartography. The fusion of these two conceptual domains provides the means to interpret the nature of maps from two distinct, but I would argue complementary, 'viewpoints' – an 'interior' view for reading the signs *within* the map, and an 'exterior' gaze revealing the power from the *around* map.

The conceptual basis of a semiotic reading of map representations is to describe how the cartographic design works in terms of both the denotative signs created by mapmakers to express meaning explicitly, and their multiple possible connotative interpretations by users of the map. As MacEachren (1995, 331) explains "[t]his is the difference between knowing that a line on a map is a boundary and what boundaries stand for in various political, community, or other contexts (i.e., what it means to establish and defend a …dividing line)." As an analytical strategy, making this distinction between denotative and connotative signs has been shown to be effective for understanding how maps work at multiple levels of meanings, some which can be quite subtle but nonetheless influential (cf. work of Vujakovic (1999a, b) reading the connotation embedded in geopolitical maps in the media). As MacEachren's boundary line example illustrates, interpreting the connotative meanings of signs has potential to generate insights into how maps emotively effect people's perceptions and modifies the understanding of space denotatively represented (although not always in the way intended by the cartographer or the institution publishing and endorsing the map). As such this analytical focus on connotative meanings is complementary with the second methodological approach employed in the thesis involving the deconstruction of maps to understand how they work as sources of power, as asserted by the critical cartography paradigm.

Broadly speaking, the goal of critical cartography as a field of enquiry is to challenge normative and conventional mapping practice (focused on technique) by employing poststructuralist approaches to deconstruct and denaturalise cartography's scientific truth claims and to demonstrate how maps are socially constructed and historically contingent (focused on political readings). The map when viewed critically, is recognised as always partial and provisional ordering of spatial knowledges, and the outcome of processes actively shaped by the choices, intentions and ideologies of map-makers and cartographic institutions.

Both semiotic interpretation and critical deconstruction see maps as cartographic texts which are more than functional, they are imbued, both, with subjective meaning and with power to do work in the world. These approaches are conceptually aligned to broader cultural re-reading of images following the 'crisis of representation' in contemporary scholarship. New visual methodologies that have emerged for analysing representations are interested in more than just the site of the image itself, seeking to untangle the full web of relationships of meaning and power in the design of signs, in the methods of production, the mode of dissemination, and contingent intertextual interpretations as they circulate and get read and re-read.

Many of the key themes emerging in semiotic interpretation and critical deconstruction of the meanings and power of maps can equally be applied to the newly emerging cartographies of cyberspace, as to old paper maps of the 'real world'. Cyberspace maps, for all their cutting-edge graphical sophistication, can be conceptualised as texts with signs open to connotative readings and structures of power-knowledge that have important, and often overlooked, social implications for how cyberspace is perceived and consumed.

1.3.1 Cyberspace cartographies

It is important not to subscribe to technological determinist notions whereby cyberspace cartographies are presented as autonomous tools and essentially benign agents operating outside of society, and which 'impacts' in predictable and universal ways, ignoring the problematic contingencies of readership and the unstable and partial connotative interpretation picked up.

If one views cyberspace cartography through a deterministic and uncritical lens then it can be seen as a logical and even 'natural' evolution of map representations, whose aim is to enhance knowledge of new virtual spaces, making online navigation (and commercial exploitation and governmental surveillance) more efficient and increasing the 'return-on-investment' in existing geospatial data by facilitating wider distribution on the Web. Making maps of cyberspace will make cyberspace a better place for business, governments and other elite institutions. However, I would argue the situation with cyberspace cartographies is much more contestable. Only certain maps of cyberspace get made and they show only certain aspects, in certain ways. They are not inherently 'good' and will certainly not be beneficial to all users and non-users of cyberspace. The mapping of cyberspace is not a benign act, instead particular maps are designed to serve certain interests.

Cyberspace cartographies do not emerge by themselves in a cultural or political vacuum. They are a product of particular individual endeavours, usually framed within institutional agendas. To really understand cyberspace cartographies, it is necessary to both interpret the semiotics of the signs within the representation and explain the power circulating 'around' the map representation itself. The theoretical tools applied here to achieve this are a combination of semiotics and political economy, what one might consider a reading of both the 'local' and 'global' contexts in which cyberspace cartographies are design and consumed. This theoretical approach to cyberspace mapping is applied to two significant case studies of maps of Internet network infrastructures in chapters five and six. The analysis has required a broad, contextual knowledge of cyberspace cartographies, synthesising materials from a wide range of sources, along with several short email interviews with map-makers to learn about their stated aims, and their professional and institutional contexts. The analysis also draws upon the wider cybergeography research I have undertaken, whose goal has been an empirically-driven auditing of the different types of cyberspace mapping, through comprehensive cataloguing and classification of artefacts, as well as providing technical and functionalist descriptions of their communicative properties (see discussion in appendix one).

The analysis is an academic critique and not a personal criticism of individuals or groups involved. It does not seek denigrate or disparage the diverse work of cyberspace cartographers, which I have found stimulating over the past ten years. It is also important to acknowledge that the 'failings' in many maps of cyberspace results from expedient design decisions by people not trained as cartographers and often working under pressure and not fully understanding the consequence of a particular cartographic choice, rather than the result of conspiracy to mislead or maliciously conceal a particular social reality[8]. Furthermore, this thesis does not provide a formal evaluation of cyberspace cartographies in terms of cognitive perception/usability testing, the customary methodological approach of researchers in the map communications paradigm, although this is in itself valuable work in regard to new map forms[9]. In some senses, it does not really matter if they look good or look bad in terms of normative design criteria or if they 'work' or do not 'work' as efficient

[8] This equally applies to geographers who use inappropriate world maps in their textbooks (Vujakovic 2002b).

[9] For example, the Spacecast project lead by Sara Fabrikant and Dan Montello behavioural testing perceptions of spatialisations (latest results, see Fabrikant *et al.* 2004; Fabrikant and Montello 2008).

communication media, for my purposes they still yield insights into their connotative meanings and their socio-political workings.

Having said that, I do believe it is important to fully grasp the normative technical scope of the maps, in terms of how they were produced (e.g., what data was used, how it was gathered and processed, and so on) and how they are designed to be used. I think the critic does need to be fully conversant with the practicalities of the maps they are critiquing. A weakness with much of social and cultural 'deconstruction' of technological phenomena, in particular, is its failure to appreciate the genuine potentialities of the technology and tendency to overstate its capacity to change social relations.

It is also important here to acknowledge my own role as an agent in actively constructing cyberspace cartographies as a coherent research topic over the past ten years through a range of print publications and a website (see www.cybergeography.org/atlas). This is discussed in appendix one.

Lastly, while this thesis does not attempt to offer a 'better' practice of cyberspace mapping that in some way 'answers' the weaknesses highlighted by semiotic interpretation or the criticisms arising from critical deconstruction, it does offer up a positive and productive re-reading of what the Internet is made to look like by challenging the truth claims of its dominant cartographic imaginary and revealing something of the partial and unstable possible readings of the maps and thus the infrastructure itself.

1.4 Structure of the thesis

The thesis comprises five main chapters, with chapters two and three reviewing relevant literatures and discussing conceptual ideas for undertaking the analysis of cyberspace cartographies. Chapter four considers how the Internet has been made knowable and tangible through spatial metaphors and various network representations. Chapters five and six are in-depth case studies interpreting specific set of examples from the 'maps <u>of</u> cyberspace' mode. The empirics focus on the geographic representation of the Internet as a material network infrastructure, examining examples, at the global scale, from two distinctive cartographic genres[10]: statistical maps and marketing maps.

Chapter two provides a substantive overview of the core elements of the research in terms of defining the nature of the map and discussing contemporary theories of mapping (particularly, the critical cartography paradigm).

Chapter three describes the three modes of cyberspace cartography, outlining their distinctive social relations, organisational settings and conceptions of space. I review the literature in the field, paying attention to the varying definitions, taxonomies and research questions relating to the cartographies of cyberspace.

Chapter four characterises Internet network infrastructures in relation to the problem of 'invisibility' and considers how they have been imagined using different spatial metaphors. The discussion then considers how the Internet is made into a tangible phenomena for scientific research by particular types of inscriptions of the network infrastructure. Using ideas from science and technology studies I argue that these network inscriptions work as a form of 'virtual witnessing' for 'matters of fact' about the Internet.

Chapter five is the first of the two case study chapters and it examines the genre of statistical cartography as deployed to map the worldwide globalisation of Internet infrastructure and use. The focus of the analysis is on global scale maps created to present different viewpoints on the scope and speed of the spread of the Internet internationally, particularly during the 1990s (a crucial phase in the maturation of the Internet, when its network infrastructure grew from technical novelty linking thousands of sites to a powerful communications medium directly connecting hundreds of millions of people). The principal actors in this mapping genre are academics, network activists and consultants, and

[10] A genre here is a distinctive type of communicative event or text which is characterised in terms of its central purpose, its prototypical content and form, it being conventionally recognised and labelled as such by the discourse community of which it is a part (Thurlow and Jaworski 2003). Genres are conventionalised, yet their boundaries are always indistinct; they are powerful because they "establish particular ways of organizing and looking at the world" (Thurlow and Jaworski 2003, 584).

international agencies and NGOs, who are working to spread Internet connectivity worldwide. They have distinctly different perspectives on the potential role of ICTs and network connectivity for social and economic development – some pushing to get everyone onto the 'information superhighway' as soon as possible, whereas others are sceptical of the benefits of such a 'digitising mission' to wire up the world. While the map texts analysed are largely conventional in cartographic design terms, they nonetheless provide a revealing connotative window into how Internet globalisation is conceived and a way to think about the political implications of a global Internet that remains unevenly distributed.

Chapter six case study is an alternative view of the evolution of the Internet gleaned through the analysis of the commercial marketing map genre of cartography. The analysis of maps deployed as integral elements of the promotional strategies of large telecommunications corporations, examines how they work semiotically and politically to sell global network infrastructure. The chapter begins with a contextual history of network marketing maps and then evaluates the importance of cartography to a sample of fifty major telecommunications companies. The analysis then proceeds with a detailed consideration of the semiotic mapping strategies for displaying networks in an advantageous fashion, illustrated with a critical comparison of the promotional cartographies deployed by five of the most significant Internet network providers who promote their global spanning infrastructures. This is followed by a tracing of the role changing marketing maps used by WorldCom in the period of commercial take-off of the Internet through the second half of the 1990s when the Web spurred unprecedented levels of hype, culminating in the dot-com bubble at the end of the decade. The analysis shows how marketing maps have an active role in the promotional discourses that lead to large speculative, and selective, overbuilding of expensive new fibre-optic cable infrastructures across the globe.

Chapter Two

Delineating the Map

A map is, in its primary conception, a conventionalized picture of the Earth's pattern as seen from above.

– Erwin Raisz, *General Cartography*, 1938.

Every map is someone's way of getting you to look at the world his or her way.

– Lucy Fellowes, Smithsonian curator (quoted in Henrikson 1994).

2.1 Introduction

Mapping provides a uniquely powerful means to classify, represent and communicate information about places that are too large and too complex to be seen directly. Importantly, the places that maps are able to represent need not be limited to physical, geographical spaces like cities, rivers, mountain ranges and such like: maps can be used to represent virtual spaces of cyberspace and their supporting network infrastructures. This chapter seeks to delineate the nature of maps and outline the major theoretical perspectives that have been used to understand and critique cartography in Western academia in the last fifty years.

The ability to create and use maps is one of the most basic means of human communication, at least as old as the invention of language and, arguably, as significant as the discovery of mathematics. The recorded history of cartography clearly demonstrates the practical utility of maps in all aspects of Western society, being most important for organising spatial knowledges, facilitating navigation and controlling territory. Some have gone further, to argue that mapping processes are culturally universal, evident across all societies (e.g., Blaut *et al.* 2003), although the visual forms of the resulting map artefacts are very diverse. At the same time, maps are also rhetorically powerful graphic images that frame our understanding of the human and physical world, shaping our mental image of places, constructing our sense of spatial relations. So, in a very real sense, maps make our world.

Conventionally, maps are material artefacts that visually represent a geographical landscape using the cartographic norms of a planar view - looking straight down from above - and a consistently applied reduction in scale. However, it is impossible neatly to define maps according to the type of phenomena mapped or the particular mode of presentation, or their medium of dissemination (Dorling and Fairbairn 1997). Maps have traditionally been used as static paper repositories for spatial data, but now they are much more likely to be interactive tools displayed on a computer screen. (Some national mapping agencies are contemplating discontinuing the printed topographic map products as customers increasingly use digital geospatial data[1]). Today, we live in a map-saturated world (Wood 1992), continually exposed to conventional maps, along with many other map-like spatial images and media (e.g., animated satellite images, three-dimensional city models, MRI scans of the brain).

Maps have long been used in scholarly research into social and physical phenomena. They provide, of course, a primary technique in geography[2] but they are also used widely in other disciplines such as anthropology, archaeology, history, and epidemiology, to store spatial information, to analyse data and generate ideas, to test hypotheses and to present results in a compelling, visual form. Mapping as a method of enquiry and knowledge creation also plays a growing role in the natural sciences, in disciplines such as astronomy and particle physics, and in the life sciences, as exemplified by the metaphorical and literal mapping of DNA by the Human Genome Project (cf. Hall 2003). This work is not limited to cartography; many other spatial visualisation techniques, often using multi-dimensional displays, have been developed for handling very large, complex spatial datasets without gross simplification or unfathomable statistical output (e.g., volumetric visualisation in atmospheric modelling, three-dimensional body imaging in medical diagnostics). "More mapping of more domains by more nations will probably occur in the next decade than has occurred at any time since Alexander von Humboldt 'rediscovered' the earth in

[1] For example in Canada, see "Ottawa plots making maps without paper", *Globe and Mail*, October 4, 2005, <www.theglobeandmail.com/servlet/story/RTGAM.20051004.wxmaps104/>.

[2] Although denigrated methodologically in some quarters; see Dodge and Perkins (2008a).

the eighteenth century, and more *terra incognita* will be charted than ever before in history" (Hall 1992, 22). Cyberspace cartographies form one of the most significant new domains of this mapping activity.

2.1.1 Mapping processes

The production of cartography and other spatial visualisation involves a whole series of mapping processes, from the initial selection of what is to be measured to the choice of the most appropriate scale of representation and projection, and the best visual symbology to use. The concept of 'map as process' is useful methodologically because it encourages particular ways of organised thinking about how to generalise reality, how to distil inherent, meaningful spatial structure from the data, and how to show significant relationships between things in a legible fashion. Mapping provides a means to organise large amounts of, often multi-dimensional, information about a place in such a fashion as to facilitate human exploration and understanding. Yet, mapping practices are not just a set of techniques for information 'management', they also encompass important social processes of knowledge construction. As scholars have come to realise, maps and culture are intimately entwined and inseparable.

Mapping not only represents reality, it has an active role in the social construction of that reality. Map-makers should be seen as creators rather than copyists of the landscapes represented. However, people are often not conscious of this constructive role when they use maps. Sparke (1998, 466) calls this the 'recursive proleptic effect' of mapping, "the way maps contribute to the construction of spaces that later they seem only to represent". The power of maps comes from the fact that they are both a practical form of information processing and also a compelling form of rhetorical communication.

Maps work, essentially, by helping people to see the unseen. This is achieved through the act of visualisation, premised on the simple notion that humans can reason and learn more effectively in a visual environment than when using textual or numerical descriptions. Maps provide graphical display which renders a place, a phenomenon or a process visible, enabling our most powerful information-processing abilities - those of spatial cognition associated with the human eye-brain vision system - to be brought to bear. Visualisation is thus a cognitive process of learning through the interaction with visual signs that make up the map and it differs from passive observation in that its purpose is to discover unknowns, rather than to see what is already known. Effective cartographic visualisation can reveal novel insights that are not apparent with other methods in terms of spatial relations, patterns and trends. In an instrumental sense, then, map use is a powerful prosthetic enhancement for the human body: "[l]ike the telescope or microscope, it allows us to see at scales impossible for the naked eye and without moving the physical body over space" (Cosgrove 2003, 137). The ideal of obtaining a reliable capacity to see the unseen is particularly applicable to much of cyberspace cartography, because of the invisibility of the infrastructure and the intangibility of the virtual spaces (see chapter three).

The power of map use as spatial visualisation to elucidate meaningful patterns in complex data is well illustrated by some of the 'classics' of pre-digital era, such as Charles Joseph Minard's 'Napoleon map' of 1869 or Harry Beck's 'Tube diagram' of 1933 (see Garland 1994; Tufte 1983). Even though these were hand-drawn on paper, they are nonetheless still powerful today and show the potential of visualisation to provide new understanding and compelling means of communicating to a wide audience. Through their novel visual forms they also demonstrate the extent to which mapping can be a creative practice in and of itself. The best maps also go beyond merely representing to become a kind of cognitive shorthand for the actual places and processes themselves, as illustrated in Beck's celebrated diagrammatic design of the Underground (the Tube map) which has become such a powerful cartographic imaginary and spatial template for the 'real' layout of London in the minds of many visitors and residents. The 'problem' is that while Beck's map works well for underground movement, it can be confusing for surface navigation because it famously sacrifices geographic accuracy for topological clarity.

Map effectiveness is also engendered because they are visually appealing objects. As Keates (1996, 174) argues art "is fundamental to cartography itself" and the aesthetic of cartographic representations is central to their success in rhetorical communication and means they are widely deployed as persuasive devices to present ideas, themes, and concepts that are difficult to express verbally (cf. Edsall 2007; Keates 1996). The result, according to Francaviglia (1999, 155) is that "[c]artographers draw maps that have the power to both inform and beguile their users". Most of the maps encountered on a daily basis (often with little conscious thought given to them) are used in the service of persuasion[3], ranging from marketing maps and city-centre tourist maps to the more subtle displays such as states' claims to sovereign power over territory, implicitly displayed in daily weather maps seen on the news. Maps work because they are able to *sell* a particular vision of the world <u>and</u> because people are willing to *buy* into this vision because they believe in the authority of the image as a trustworthy representation.

The persuasive power of 'informative-yet-beguiling' maps is equally applicable to cyberspace cartography projects. Indeed, much of this mapping is used precisely because it has an appealing visual sense of what cyberspace *should* look like, matching the metaphorical preconceptions of the designers, journalists and editors. (See chapter four for discussion of the visual tropes used to spatially imagine Internet infrastructure.) Yet, the lack of established conventions in mapping aspects of cyberspace (what should a map website look like?[4]) have provided significant scope for design and aesthetic experimentation. And in this regard, some of the most innovative cartographies of cyberspace are pushing the definitional boundaries of the map (as opposed to a graph or merely a 'pretty picture'). As such, I would argue, cyberspace cartography is one of the few genuinely 'cutting edge' developments in map design practice in the twenty-first century.

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[3] Many of these illustrations are what is known as 'popular' maps and they use figurative infographics style rather than geometrically accurate representations (see Holmes 1991).

[4] A diversity of metaphors and design styles have been developed, see Kahn (2000) for examples and discussion of some of the issues.

2.2 Cartographic history, mapping modes and the digital transition

Attempts to historicize the nature of (Western) cartography through categorisations of map forms and taxonomies based on purpose often implicitly use the notion of evolutionary advancement driven by technological development as an explanation. The end result, often conceptualised as a tree (Figure 2.1), narrates cartography as a beneficent pursuit, characterised by improving accuracy and comprehensiveness with each new generation of map. Examples of this conceptualisation are quite common in the literature, such that "[t]he normative history of cartography is a ceaseless massaging of this theme of noble progress" (Harley 1992, 234). For example, Crone (1953, xi) notes, "[t]he history of cartography is largely that of the increase of accuracy with which ... elements of distance and direction are determined and the comprehensiveness of the maps' content.".

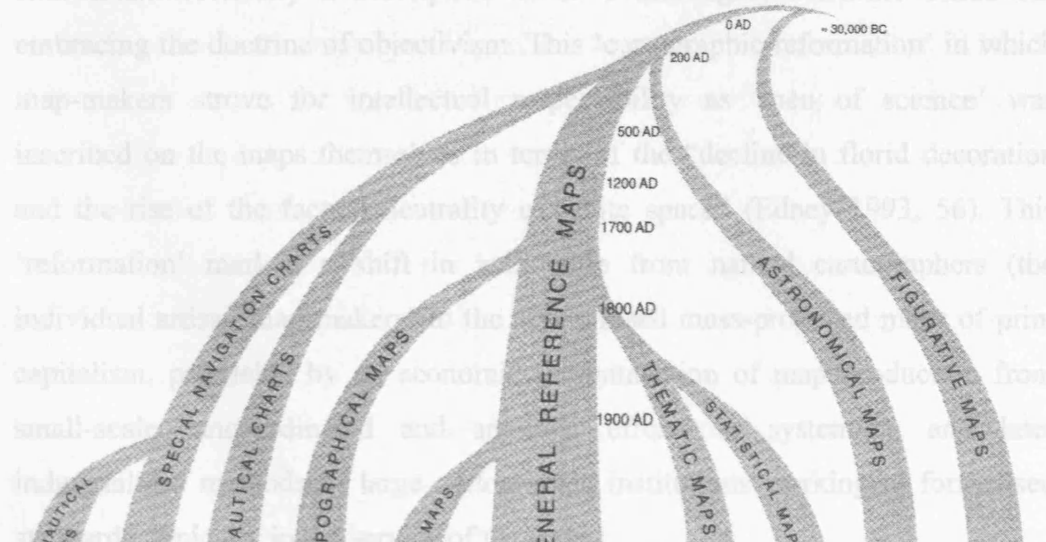

Figure 2.1: Cartography explained as a 'story of progress'. Mapping is shown to evolve over time with the development of increasingly complex forms. (Source: Robinson *et al.* 1995, 22.)

Histories of cartography tend to be written as a history of technique, with an underlying assumption that rational decision-making leads to the adoption of improved technologies and institutional practices when they become available. In some narrative histories cartographers are portrayed as benign artisans and later skilled technicians striving to make ever more accurate depictions of space. Technical development is conceived as a continuous path of improvement, punctuated with particular bursts of intense innovation and progress (e.g., John Harrison's 1761 invention of the chronometer and the reliable production of longitude at sea; cf. Sobel 1995). Within this 'onward march' view of map-making history, distinct phases are conveniently identified: the Eurocentric sequence runs typically through primitive medieval cartography based on religious imagination, followed by revolutions in measurement and projective geometry, flowing from Ptolemaic geography, leading to Renaissance mapping and the first atlases, then moving forward with the scientific formulations of the Enlightenment and geodetic national surveys, ending up with the most 'advanced' digital map-making founded on GIS and GPS technology. Above all else, such 'progressivist' narratives stress the changes in (Western) cartography's state from essentially a descriptive art to a thoroughly scientific endeavour embracing the doctrine of objectivism. This 'cartographic reformation' in which map-makers strove for intellectual respectability as 'men of science' was inscribed on the maps themselves in terms of the "decline in florid decoration and the rise of the factual neutrality of white space" (Edney 1993, 56). This 'reformation' marked a shift in authorship from named cartographers (the individual artisan map-makers) to the anonymised mass-produced maps of print capitalism, paralleled by an economic reorganisation of map production from small-scale, uncoordinated and sporadic efforts to systematic and later industrialised methods of large cartographic institutions working to formalised standards, typically in the service of the state.

The apparent 'naturalness' of this account belies the politics behind the conceptualisation of the progressive development of cartography from a primitive past to the sophisticated present (Edney 1993; Pickles 1999). The underlying goal of this kind of construction of cartographic history - achievable only through a carefully selective reading of extant map artefacts according to Edney (1993) - is to 'prove' that the objectivity of *current* scientific methods is predestined. It grants an important legitimation to the positivist notion of contemporary professional cartography as the 'best' and provides a discursive mechanism to dismiss maps that do not fit 'acceptable' scientific standards (e.g., dismissal of non-Western mapping practices). Social studies of science have shown that this type disciplinary 'storytelling' is a form of scientism, a metanarrative underlying modernist science's claims to exclusive truth based on the superiority of empirical measurement to describe reality and the privileging of the resulting representations. Scientific worldviews see technological progress almost like a force of nature that somehow operates outside society and beyond the political concerns of money, power, and ego. The way one approaches cartographic history is therefore worthy of consideration, as it is at the heart of the recent political theorisation of cartography and directly informs our understanding of the nature of the map and contemporary positivistic epistemological foundations of cartography (including much of the work mapping cyberspace).

There are alternative ways to conceptualise cartographic history that are not so wedded to modernist narratives. One of the most useful is provided by Edney's (1993, 54) theorisation of 'cartography without progress', in which mapping is read as "a complex amalgam of cartographic *modes* rather than a monolithic enterprise". For Edney, a cartographic mode is not simply a time period in a linear chronological sequence, but is a unique set of cultural, social, economic and technical relations within which cartographers and the map production processes are situated. The mode is the milieu in which mapping practices occur. Each cartographic mode gives rise to its own kind of map artefacts, and these may well look different from other modes, but critically this conceptualisation does not assume that one is inherently better than another, or that one mode will inevitably evolve into a 'better' mode. As Edney (1993, 58) says: "[t]he mode is thus the combination of cartographic form and cartographic function, of the internal construction of the data, their representation on the one hand and the external *raison d'être* of the map on the other". Modes are unique to their time and places, and are transitory. There can be multiple distinct cartographic modes operating at the same time, in the same place. Modes can interact and may well overlap, merge or split. The boundaries between modes are likely to be fuzzy and permeable.

Cartographic history, according to Edney's theorisation, is a pluralist and relational network of activities rather than a single linear process. The end result is not the unidirectional evolutionary tree but a complex, many-branching, rhizomatic[5] structure (Figure 2.2). In contemporary cartographic epistemologies, a diverse range of mappings is seen to emerge from a shifting creative milieu rather than in a systematic fashion.

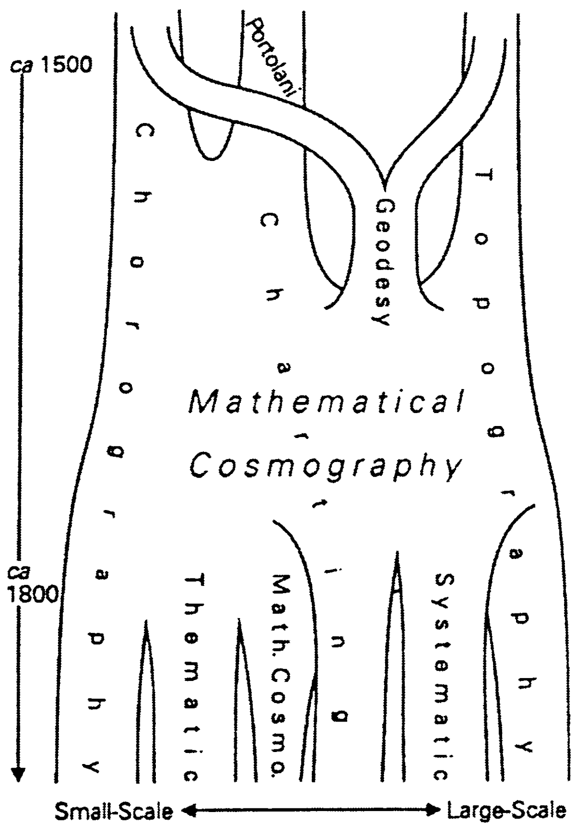

Figure 2.2: Cartography alternatively characterised as a rhizomatic network of competing and overlapping modes of mapping. This example shows the post-Renaissance convergence of modes into mathematical cosmography and then the gradual bifurcation into several more distinctive modes following the Enlightenment. (Source: Edney 1993, 59.)

As stated in the introduction, the theorisation of this thesis is built on modes rather than trees. The development of new forms of contemporary mapping practices and artefacts - what I term cyberspace cartographies - is best conceptualised as three distinct modes rather than a new branch at the end of the

[5] A rhizome is a tangled root system that develops horizontally, and in a non-hierarchical fashion.

family-tree of cartography history. The rhizomatic notion of cartographic modes suits the emergent and variegated nature of cyberspace mapping, which has drawn on many disparate ideas, approaches and visualisation forms; it is thoroughly situated in wider socio-technical changes (particularly the diffusion of the Internet throughout map production and the use of the Web as the primary media of dissemination). The empirical analysis (presented in chapters five and six) tries to unpack the some of cultural, social, and technological relations which determine the cartographic practices of one of these modes, the 'maps of cyberspace' mode, using a range of cartographic genres from Internet network infrastructure mapping.

2.2.1 Digital transition and cartography

The development and rapid diffusion of information and communication technologies in the last three decades has affected all modes of mapping, changing methods of data collection, cartographic production, and the dissemination and use of maps. This has been termed the 'digital transition' in cartography (Goodchild 1999; Pickles 1999) and it is continuing apace (for example, developments in satellite navigation displays and mobile mapping services). As such it is a vital component in understanding the milieu in which new modes of cartography are emerging.

While the detailed social and technical histories of the digitisation of the cartographic industry are complex and largely unwritten, it would be fair to say that in the last decade cartography has been almost wholly subsumed in a rapid convergence of spatial technologies, such that today, professional cartography is seen as little more than an 'end-service' component of the multi-billion dollar GI industry. Nowadays, the majority of maps are digital and created only 'on demand' from geospatial databases for temporary display on screens. The days of the unwieldy folded map sheet and heavy paper atlases are quickly becoming a thing of the past, replaced by the rapid technological development of GIS, spatial databases and real-time navigation systems. The Web mapping portal MapQuest.com, for example, has already generated more digital maps than any other publisher in the history of cartography (Peterson 2001); the huge popularity of Google map's API[6] in the summer of 2005 has inspired an explosion of new online mapping tools and hacks (see Gibson and Erle 2006), and there is even the prospect that GIS itself will begin to adapt and evolve around such a Web services mapping model.

As the map itself has became a fully digital text, many of its basic properties have changed. The digital map is infinitely copiable, infinitely transportable, and a highly mutable representation (switching thematic layers on and off, easy modification of symbols, the ability to make selections by spatial/attribute queries, and so on). Cheap, powerful computer graphics on desktop PCs, and increasingly mobile devices, enable much more expressive and interactive cartography, potentially available to a growing number of people. The pervasive paradigm of hypertext as a way to structure and navigate information has also influenced digital maps. Increasingly, maps are used as core components in larger multimedia information resources where locations and features on the map are hotlinked to pictures, text and sounds, to create distinctively new modes of map use (Cartwright *et al.* 1999). In design terms, the conventional planar map form itself is, of course, only one possible representation of spatial data and new digital technologies have enabled much greater diversity of forms including pseudo three-dimensional landscape views, interactive panoramic image-maps, fully three-dimensional flythrough models, and virtual globes (e.g., Fisher and Unwin 2001; Goodchild 2008; Hudson-Smith 2008).

Developments in computer graphics, computation and user interfaces have begun to fundamentally transmute the role of the map from the finished product to a situation where the map is displayed within a visual tool to be used interactively for exploratory data analysis (typically with the interlinking of multiple representations such as statistical charts, three-dimensional plots, tables, and so on). This changing conceptualisation of the map is at the heart of the emerging field of geovisualization, which in the last five years or so have been one of the leading areas of applied cartographic research (cf. Dodge *et al.* 2008; Dykes *et al.* 2005; MacEachren and Kraak 2001).

[6] An API (Application Programming Interface) allows technically savvy users direct access to the database enabling sophisticated and novel third-party applications to be developed.

As well as making maps more interactive, information and communication technologies (ICTs) are also helping to give many more people access to cartography as map-makers themselves, be it via the 'map charting' options in spreadsheets to produce simple thematic maps of their own data or through desktop GISs such as ArcView or MapInfo. As more and more people 'by-pass' professional cartographers to make their own maps as and when required, it is likely that the diversity of map forms and usage will expand. Of course, access to 'point and click' mapping software itself is no guarantee that the maps produced will be as effective as those hand-crafted by professionally-trained cartographers (C. Board, PhD examiners report, 24th October 2006).

Developments in networking and computer-mediated communications, and the rise of the World-Wide Web in the mid 1990s, means that digital maps are now very easy to distribute at marginal cost and can be accessed 'on demand' by many (see Kraak and Brown 2001; Peterson 2003a and 2008; Plewe 1997). One of the first examples was the Xerox PARC Map Viewer[7] online in June 1993 and the threshold of online mapping continues to rise (e.g., in June 2005, Google Maps service provided seamless satellite image coverage of the world). These Web mapping services are free at the point of use and are encouraging the casual use of cartography[8].

The provision of Web mapping and online GIS tools is significantly shifting the accessibility to mapping and spatial data, as well as altering the user perception of what a map should be. There are clear signs that cartography will be seen as simply one of many available 'on demand' Web services. As the digital map display becomes more flexible and much more accessible, it is also, in some respects, granted a less reified status than analogue map artefacts of the past. Maps are increasingly treated as transitory information resources, created in the moment, and discarded immediately after use. In some senses, this devalues the

[7] Created by Steve Putz. The map is no longer online, however further background details are available at <www2.parc.com/istl/projects/www94/iisuwwwh.html>.

[8] Although, there are many much thornier, political, issues about access rights and intellectual property, especially so in the UK; see for example Dodson 2005.

map as it becomes just another form of ephemeral media, one of the multitude of screen images that barrage people everyday. Cartographic knowledge itself is just another informational commodity to be bought and sold, repackaged and endlessly circulated[9].

The production of cartographic knowledge has always been dependent, to large degree, on the available methods of data collection. These are being greatly augmented in the digital transition. The wide-spread importance of new digital measurement was noted by U.S. National Science Foundation Director Rita Colwell (2004, 704): "new tools of vision are opening our eyes to frontiers at scales large and small, from quarks to the cosmos." Cartography's ability to 'capture' the world has been transformed by digital photogrammetry, remote sensing and GPS-based surveying. Cartography can not only 'see' the world in greater depth (Pickles 2004b), but it can also 'see' new things (including virtual spaces), and with new temporalities.

Vast geospatial databases underlie the modern digital topographic maps, such as the Ordnance Survey's Digital National Framework comprising over 400 million features.[10] These are growing as part of the 'exponential world', being fed in particular by high-resolution imagery from commercial satellites. Interestingly, in the future, much of this growth will come from people gathering geospatial data as they go about their daily activity, automatically captured by location-aware devices that they will carry and use. From this kind of emergent mobile spatial data capture it will be possible to 'hack' together new types of maps rather than be dependent on the map products formally published by governments or commercial firms. Such individually-made, 'amateur' mapping may be imperfect in many respects (not meeting the positional accuracy standards or adhering to the TOPO-96 surveying specifications for example), but could well be more fit-for-purpose than professionally produced, general map

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[9] The emergence of open-source cartography, as exemplified by the OpenStreetMap project, has the potential to challenge the commercial commodification of geospatial data by developing a 'bottom-up' capture infrastructure that is premised on a volunteerist philosophy (Perkins and Dodge 2008).

[10] Source: <www.ordnancesurvey.co.uk/oswebsite/media/news/2001/sept/masterchallenge.html>.

products[11]. There is also exciting scope for using locative media to annotate our maps with ephemeral things, personal memories, messages for friends, that are beyond the remit of governmental cartography or the commercial cartography industry[12].

In some respects, then, the outcome of the digital transition can be read as a democratisation of cartography, widening access to mapping and breaking the rigid control of authorship by an anonymised professional elite. However, if one looks more closely (and sceptically), the freedom for people to make their own maps with these types of software tools is strongly inscribed in the design and functionality of the software itself. The maps one can make in Excel or ArcView are only the maps the program allows one to make. The majority of people still do not have the time or skills to break free from the functional constraints that the software imposes[13]. Google may currently make a vast amount of mapping freely available online (supported by advertising) but it is subject to their terms and conditions of use and raises risks of monopolistic provision (cf. Zook and Graham 2007).

Furthermore, interpreting the digital transition should not merely be about plotting technical 'impacts', but should also involve assessing the political implications of changing social practices in data capture and map authorship. Being wary of linear narratives of progress, one should not read the digitisation of the map as seamless, unproblematic or inevitable (Pickles 1999; 2004a). Technological change is always contested, driven by competing interests and received in different ways and at different speeds in particular institutional settings. Technology is never a neutral actor. It is shaped by social forces and is bound up in networks of power, money, and control of new institutional practices

[11] Of course, many would argue that Ordnance Survey mapping is not perfect or perfectly accurate (source: C. Board, PhD examiners report, 24th October 2006).

[12] An example would be Christian Nold's on-going emotion mapping project, <www.emotionmap.net>.

[13] See Fuller's (2003) analysis of the framing power of Microsoft Word on writing and Tufte's (2003) trenchant critique of Microsoft PowerPoint on how people give presentations. The effect of the software 'defaults' on the look of maps produced by GIS packages such as ArcView and MapInfo is also evident in a good deal of generic presentation cartography produced these days.

in the processes of cartographic digitisation - and the benefits and costs are never felt evenly. "The mappings of the digital transition have their own geographies" Pickles (2004a, 149) argues, which are intimately bound-up with "new Americanism, a thorough-going post-Fordism, and a resurgent geopolitics of global hegemony." Government agencies and large commercial mapping firms have invested heavily in digitisation not from enlightened ideals to improve cartography but because it serves their interests (such as to maximise efficiency, to reduce costs by de-skilling production), and to boost revenues. The popular discourses of digitisation in cartography and elsewhere are often uncritical, driven in large part by the boosterism of the vendors of hardware, software and IT consultants offering 'solutions'. The reality of the 'messy' social aspects of digitisation are glossed over in techno-utopian fantasies.

As such, the transition has made it more urgent to understand the wider social milieu in which maps are produced and disseminated, because as Harley (1992, 231) argued at the start of the 1990s, digital cartography and GIS works "to strengthen its positivist assumptions and it has bred new arrogance in geography about its supposed value as a mode of access to reality." One needs to realise that the path of digitisation in cartography has been driven in large part by militaristic interests in various guises (e.g., Cloud 2002). The underlying geospatial technologies and capture infrastructures (such as earth imaging and GPS) are still dependent on state funding and imperatives of territorial security. Rather than becoming more democratic, one could argue that the surveillant power of the cartographic gaze is deepening, particularly after 9/11 (Monmonier 2002), accompanied by a fetishization of the capability of geospatial technologies to 'target terrorism'. The mundane disciplining role of the digital map in systems of computerised governmentality continues to grow, for example in consumer marketing and crime mapping (Crampton 2003). Such surveillance requirements are also a key driver in the development of new mapping techniques for cyberspace (e.g., Gorman's (2004) work mapping infrastructure networks in the U.S. to assess their vulnerability to attack). In conclusion, Pickles (2004a, 146) notes cautiously: "As the new digital mappings wash across our world, perhaps we should ask about the worlds that are being produced in the digital transition of the third industrial revolution, the conceptions of history with which they work, and the forms of socio-political life to which they contribute."

2.3 Cartographic theories

The theoretical perspectives in academic research that seek to understand the nature of cartography - both the map as object and wider conceptions of mapping practices - can be grouped into three broad but distinct paradigms, each based on a common set of beliefs about what represents a valid area of research[14]. These respectively conceptualise cartography as (1) a means of communication, (2) a form of representation, or (3) an expression of power. These three different theoretical approaches provide a useful way to begin to understand how scholars have interpreted, analysed and read the nature and meaning of cartography in recent history.

These theoretical positions have framed the types of 'questions' that are asked of the map and, therefore, the ways of approaching empirical cartographic research, and they have also informed the way cartography is taught[15]. It is clear that scholarly cartography research remains a contested subject, with significant alternative epistemologies in play, and offers no definitive answers (there is no 'true' nature of the map in some senses). As such, I concur with Perkins (2003, 342) when he says "it makes more sense to understand contrasting approaches as representing different knowledge communities telling very different stories." As outlined in the introductory chapter, I employ a hybrid theoretical 'story' which uses concepts from both the 'maps as representation' and the 'power of maps' knowledge communities. This theoretical frame is applied to interpret the

[14] It should be acknowledged that attempts to impose simple paradigm categories inevitably means the lost of much detail and nuance in such narratives. Describing trends through paradigms can also be problematic as it creates sharp divides, where scholar often come to see those work in supposedly 'opposing' paradigms as threats to their ideas and unjustly undermine their work through caricatures and 'straw-men'. As Keates (1996, 192) put it: "the arguments are sustained by all sorts of unproven assertions, and the well-known 'rhetorical' device of misrepresenting the views of the 'opponent' in order to demolish them."

[15] Although, they have often had little impact beyond the academy on practising cartographers; as Petchenik (1983, quoted in Keates 1996, 188) says "specialization in cartography has developed to the point where academic studies of map design and map use may be completely divorced from the non-academic, routine map production milieu."

cartographies of cyberspace as both sign systems with important connotative meanings and as social constructions that do work in the world. I review the major focus of the three paradigms in turn as these shed light on the types of analytical work that has been done in analysing different modes of cyberspace mapping.

2.3.1 Cartography as communication

> It is a truism to assert that maps are vehicles for the flow of information. Some are better vehicles than others, but the functions they perform are nevertheless similar, irrespective of their quality. It is instructive to look at the role of maps in an adaptation of a general communications system. (Board 1967, 673)

The dominant theoretical paradigm in academic cartographic research in the last forty years or so (1960s-90s) has been based the 'map communication model'. Developing from initial but significant conceptualisations espoused by Moles (1964), Board (1967) and Koláèný (1969), the goal of this theoretical approach, broadly speaking, was to work to improve cartography by determining how map representations communicate geographic information to the user, primarily through psychological testing. The appeal of such an experimentalist approach was its potential to systematically determine the parameters of the map user's capabilities in reading, comprehending and remembering information from different types of cartographic representations. Board and Taylor (1977, 19), in their review of preliminary work on design and map perception, argued it was important for advancing cartographic communication research that, "realistic map-reading tasks should be used in experimental evaluations". Such work would generate robust psychophysical data which could, in turn, form the basis for quantifiable, consistent rules for the most appropriate cartographic design decisions (such as symbol sizes, colour ranges, classification schemes and so on; see, for example, MacEachren's (1982) work on design parameters and complexity in thematic maps). Such striving for objective rules in map design was premised on the positivistic belief that it was possible to produce *optimal* mapping for a given purpose and the acceptance of cartographic research was able to produce more 'accurate' mapping in terms of effective communication to the reader.

In the communications model there is a clear distinction made between the map-maker and the map user, with the map representation itself being essentially a neutral medium of one-way information transmission between the two. Accordingly, Robinson and Sale (1969, 18) asserted: "Maps today are strongly functional in that they are designed, like a bridge or a house, for a purpose. Their primary purpose is to convey information or to 'get across' a geographical concept or relationship; it is not to serve as an adornment for a wall." The model was often depicted in a summary flow chart as a linear process with distinct entities and a directed flow of information from originator to receiver (Figure 2.3). The role of the cartographer in the model was cast as someone who essentially works in a technical, impartial way, taking a body of geographic data and applying rules of functional design, which resulted in a map that works as a 'scientific' tool for the visual communication of the information in the public realm. Map users were accordingly afforded a relatively passive role of readers as receivers of a fixed message from the cartographer.

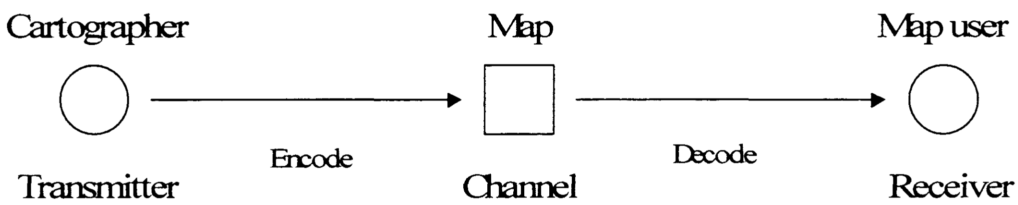

Figure 2.3: The basic map communication model, conceptualising cartography in terms of stages in the transmission of spatial data from cartographer to reader via the map. (Source: redrawn from Keates 1996, 114.)

The 'map communication' paradigm marked a significant epistemological shift in cartographic research and its advocates, led by Arthur H. Robinson, wished to remould cartographic scholarship as a scientific practice, moving it away from its existing interpretative, qualitative and artistic nature. This major modification to map theorisation was itself bound-up with rapid quantification and a rush to more 'scientific' methods of research in the late 1950s in other social science disciplines, including human geography and psychology. The basic premise of the 'map communications model' held sway for decades in Anglo-American academia and was a major influence in cartographic education, as can be clearly seen in the content of leading English-language textbooks such as Robinson's *Elements of Cartography* (which went through six editions, with various coauthors, from 1953 to 1995) and Dent's *Cartography: Thematic Map Design* (which went through five editions).

By the 1990s, the dominance of the 'map communication' paradigm had waned considerably, as the focus of scholarly cartography research shifted direction and methods of behavioural psychological testing were discredited as excessively reductionist. Although it contains much of practical value, especially in teaching notions of effective map design, the tide of academic ideas has moved against its agenda, driven in part by rapidly changing technology (many researchers having moved into research in GIS and geographic visualisation), and also the 'cultural turn' in theoretical perspectives in the social sciences. Some of the key concepts of 'map communication' theory have been challenged in the last decade or so by scholars advocating a different cartographic theorisation, in which mapping is conceptualised cognitively as spatial representations that can have multiple semiotic meanings and uses, and where the map reader actively constructs knowledge from the representation in relation to their particular experience, skills and circumstances. The role of the cartographer as the primary arbiter of a single message encoded in the map is questioned.

Having said this, the 'map communication' paradigm still has influence, particularly in U.S. cartographic research (Montello 2002) and important work being done around map perception (such as Brewer's influential work on optimising colour selection on thematic maps[16]). Much of the recent work on Web cartography, for example, has a distinctly 'communicative' epistemology, with its focus on testing users and determining new map-design guidelines for optimum graphical presentation for Internet media (e.g., Kraak and Brown 2001; various chapters in Peterson 2003a and 2008), Fabrikant work on evaluative testing of the informational meanings users gain from spatializations (Fabrikant

[16] One of the novel outputs of this research is the online tool called ColorBrewer that mapmakers can use to select colours for their own cartographic design work; available at <www.personal.psu.edu/cab38/ColorBrewer/ColorBrewer_intro.html>.

et al. 2004; Fabrikant and Montello 2008); while Jiang and Ormeling's (1997, 112) initial analysis of 'cybermaps' is premised on the notion of optimising map design, in which they claim: "in long standing cartographic practice, maps have been considered as communications tools".

2.3.2 Cartography as representation

> The map is examined here.... not as a communications vehicle but as one of many potential representations of phenomena in space that a user may draw upon as a source of information or an aid to decision making and behaviour in space. (MacEachren 1995, 12)

A new paradigm has emerged in academic cartographic research, since the early 1990s, that views the map as a representation which should be analysed and understood through a combined cognitive-semiotic lens. The paradigm is best articulated by MacEachren's (1995, 12) book 'How Maps Work' where he argues, "[e]mphasis is placed on how the map 'represents' in both a lexical and a semiotic sense and how vision and cognition represent that representation in forms that allow the map viewer access to meaning."

In some respects the 'representation' approach has significant commonalities with both the other two active cartographic research paradigms identified here. In terms of the focus on the cognitive understanding of visual processing, particularly through experiments using visualization software, the 'representation' paradigm has strong methodological and ontological overlaps with the 'communication' paradigm. While the semiotic component of the 'representation' paradigm, seeking to understand the meaning of representational signs has significant accordance with the 'critical cartography' agenda to expose the 'hidden' power of the map.

Given the dual aspects of the 'representation' paradigm, and there potential relevance to the analysis of various aspects of the cartographies of cyberspace, it is worthwhile to discuss, firstly, how semiotics might have utility in unlocking meanings in the map and, then, to consider how an interest in the cognitive basis of cartography is being advanced in applied research on visualization, particularly building and testing realistic and multi-modal interactive mapping software.

2.3.2.1 Lexical understanding of representation through semiotics

Semiotics is the study of signs, concept-objects that, it can be argued, are fundamental units of understanding that humans use to make sense of the world and to communicate ideas and exchange information. Language and visual representations (including maps) are lexical, being composed of signs that carry messages/meaning about things or concepts. As Pierce, one of the founders of semiotics, put it: "something stands to somebody for something else in some respect or capacity." (quoted in MacEachren 1995, 213). A sign on a map represents things from reality to somebody. The 'sign' has been theorised in a multitude of ways in different areas of scholarship, but in simple terms can be thought of as concept-object comprising three distinct parts which work in relation (Figure 2.4).

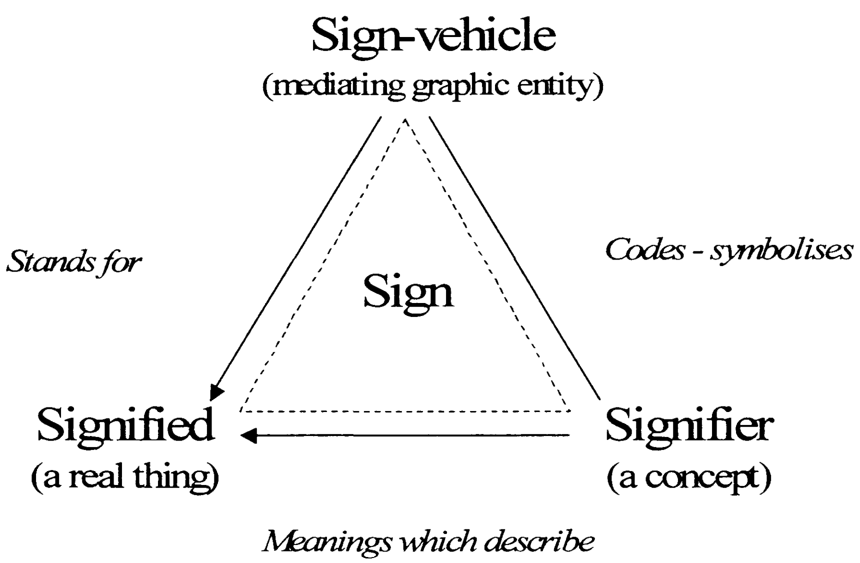

Figure 2.4: A simplified notion of a sign as a triangular relation.

The three parts of the triangle operate in unison to represent something by creating a unit of understanding. This is done by assigning a meaning (signifier) to something (signified) by a mediating sign-vehicle. In the cartographic case, a sign-vehicle is a graphic element on the map itself (a blue line symbol say) which is a signifier (for rivers) which describes, through meaning, a signified instance (a 'real' river, with attributes and located in space and time). (At another scale, the map as a whole could be viewed as a single sign within a large system of signs, such as a book.) The relations between the sign-vehicle and signifier are potentially made up of multiple codes (e.g., symbols to code a river); and for visual representations have been classified into various kinds typologies of design codes (which are often complex and hard to apply to real data). Codes of sign-vehicles for cartographic design can be classified in various ways, including according to their visual iconicity, running on a continuum from wholly mimetic symbols which are pictorial equivalents of the real thing (e.g. a bike representing a cycle path) to completely arbitrary symbols which only represent the real thing when specified to be so (e.g., a triangle symbol representing a post office).

Of more interest for understanding cartographic representations is the outcome of the relationship between signifier and the signified (mediated by the sign-vehicle) as this gives rise to meanings in mind of the reader about mapped reality. Such meanings can be multiple, unstable and unanticipated by sign maker (i.e., cartographer). Meanings are dependent, in varying degrees, on the social context of the sign and the experience of the reader, i.e., meanings often lie beyond the map and are brought to it. As MacEachren (1995, 311, original emphasis) notes, therefore, "a lexical approach to cartographic representation accepts a potentially broad range of *legitimate meaning* for individual or groups of signs. The issue of correct or incorrect signs becomes secondary to that of exploring the various perspectives from which, or levels at which, map signs might be understood."

There is no universal set, or guaranteed single, meaning for a given sign, although social convention and lived experience means that most people, most of the time, will get broadly similar meanings from the same signs. For understanding maps then, one of the goals of semiotic analysis is to trace out the multiple levels of meaning created by a sign and think through the implications of this for how maps are used in the world.

In tracing out meaning in signs, researchers have found it useful to try to categorise them. One useful categorisation, that has been applied productively for cartographic interpretation, is a division of meaning into two levels,

Denotative	Connotative
Explicit, primary	Implicit, secondary
(overt, obvious)	(hidden, unspoken)

The difference in levels is significant, as Guiraud (1975, quoted in MacEachren 1995, 229) puts it: "A uniform denotes rank and function; it connotes the prestige and authority attached to rank and function." Moreover, in maps, according to MacEachren (1995, 311), "denotative meanings [are] either specified precisely in a map legend or assumed to be part of the normal reader's general map schema", (e.g., the blue line has specific meaning of 'rivers'). Connotative meanings are latent and contingent, but can be as important, and on occasion more important, than the denoted meaning of a sign. For example, Vujakovic (2002b, 372, original emphasis), in his interpretation of world maps in textbooks, says about the (problematic) different meanings of the Mercator projection: "[w]hile direction, and to some extent continental shape, are (correctly) *denoted*, the choice of this projection for a map would create, through its usual centring on Europe, its orientation, and its exaggeration of higher latitude landmasses, a false *connotation* of the importance of Europe." Connotative meanings can be picked up unconsciously and can be obscure (they exist only in the 'eye of beholder' but are nonetheless real meanings; this has methodological issues for decoding them), and may not have been in the mind of the sign maker (cartographer). The kinds of intention that lies behind a connotative meaning attached to a sign is an important philosophical/ethical divide between the 'critical' and 'representation' paradigms. Critical deconstruction would typically see connotative meanings as insidiously hidden, manipulative and created with malicious intent on the part of the cartographer. A representational point of view, as espoused by MacEachren (1995) for example, would tend to see connotative meanings as largely 'innocent' and unintended by the cartographer.

Accepting that connotative meanings can be of different kinds also implies the potential to derive potentially useful and useable typologies of meanings. MacEachren (1995, 336-338) presents his initial typology of map connotation, which he acknowledges is tentative. The typology schema has two high levels and then a five level subdivision, as follows:

1. Connotations about the map
    1.1. Connotations of veracity (people believe maps because they think they are free from error),
    1.2. Connotations of integrity (people believe maps, especially official ones, because they think they are free from bias),
2. Connotations about the topic mapped:
    2.1. Valuative connotation (maps proffer a value judgement),
    2.2. Incitive connotation (maps are intended to arouse emotions and prompt particular actions),
    2.3. Connotation of power (maps often exert control over places or people)

MacEachren only provides limited hypothetical examples to support each category in his typology and they remain largely untested. It is also apparent that they overlap with map deconstruction espoused by 'critical cartography' paradigm, discussed in section 2.3.3 below.

The classification of denotative and connotative meanings of map signs is an analytic that begins to get at the different affects maps have on people's understanding of what is being represented, of how people understand the mapped reality. Given that connotative meanings are not explicit, a method of analysis is need to expose them. MacEachren (1995) advances two routes, firstly, that of intensive and careful individual reading and hermeneutic interpretation by the researcher and, secondly, a more quantitative semantic differential testing using multiple human subjects. The second method has been applied to map signs, for example in classic early work by Petchenik (1974) and more recently by Harrower *et al.* (1997) investigating the meanings of online maps. The first method for decoding connotative meanings has also been profitably applied to understanding cartographic representations, often drawing on an intertextual reading of map materials from competing sources; examples include Vujakovic's (1999a and b) work interpreting the mapping of changing European geopolitics as presented in newspapers; Edsall's (2007) work on the meanings of national and world maps as deployed in U.S. political campaigning; and Kosonen's (2008) analysis of the meanings of maps portraying the emerging Finish national identity in the first half of the twentieth century. As noted previously semiotic analysis of connotative meanings is one of the methods used in this thesis to understand the two different genres of maps of Internet infrastructure. Chapter five analyses statistical maps of Internet globalisation using a four fold typology of connotative meanings based around axis of 'difference' and 'complexity'. Chapter six considers marketing maps used by Internet network operators to promote their infrastructure and deploys a typology of eight connotative meanings that work to demonstrate that the company has the 'biggest and best' network, that the network is a tangible entity and that the network can be trusted.

2.3.2.2 Cognitive understanding of representation through visualization

Besides an interest in semiotics, another central focus of the 'representation' paradigm has been on the visualization of geographic data (rather than on its communication), which according to one of it leading practitioners, is focused on researching "human-centred methods and technologies that make it possible for scientists and decision-makers to solve scientific, social and environmental problems through computer-supported, visually-enabled analysis of the growing wealth of geospatial data" (Peterson 2003b, 441). To a large degree its research questions and methods of work have been driven by computer technology, with the digital transition of the map and rise of GIS being the crucial catalysts for new research questions. In this sense, visualization research in the 'representation' paradigm can be characterised as a tool-driven epistemology.

A core concern for visualization research has been to examine the potential of interactivity and multi-modal computerised graphic displays of cartographic information and how this can facilitate so-called 'knowledge discovery' by users. Consequently, the typical separation of reader from cartographer inherent in the communication paradigm collapses. Map users make their own map; they are actively engaged using their innate cognitive capability, combined with interactive displays, to analyse geographic patterns and visually explore spatial relationships in the data. The map is not a fixed communicative artefact for public presentation, but an element in a process of individual exploration in private environments (Figure 2.5). The research goal is no longer to produce optimal map design rules, but to develop better visualisation 'toolboxes' that can most effectively support 'visual thinking'- "the generation of ideas through the creation, inspection, and interpretation of visual representations of the previously non-visible" (DiBiase 1990, 4). A great deal of this work is influenced by ideas, techniques and experiences from scientific visualisation and computer science research in interactive graphics and virtual environments. A good amount of research being undertaken in terms of visualisation is also relevant to understand the interactivity and user-controlled representations produced to map cyberspace.

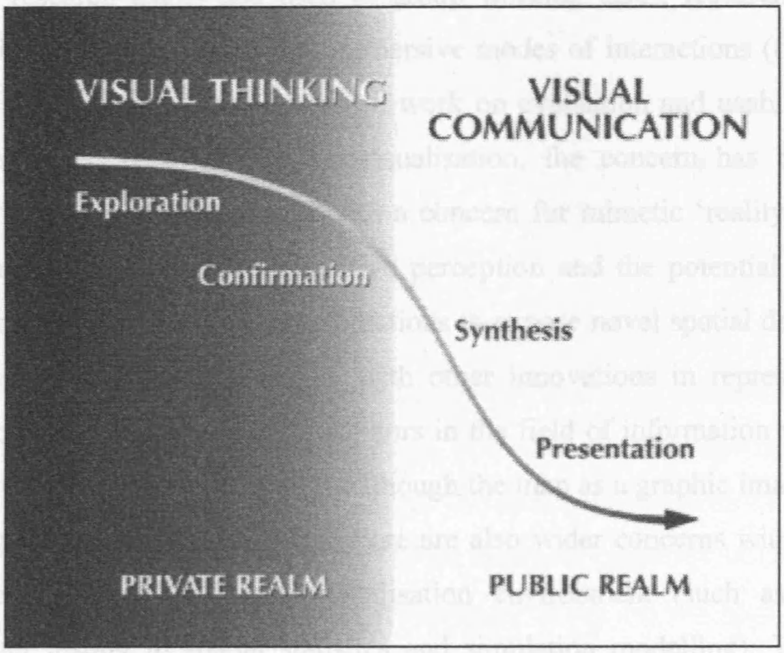

Figure 2.5: DiBiase's conceptualisation of role of cartography in the research process. The focus of the 'map communication' paradigm is on optimising cartography for use in the right hand side of the diagram, more recent work under the rubric of cognitive geovisualisation is concerned with developing cartographic tools for use in the left hand part of the process. (Source: DiBiase 1990.)

Proponents of 'representation' as a form of geographic visualisation (so-called geovisualisation), have argued ebulliently that it represents "the most important development in cartography since the thematic mapping 'revolution' of the early nineteenth century. For map users, [it] represents nothing less than a new way to think spatially" (MacEachren 1995, 460). The direction of this paradigm through the last five years or so has been set, in large part, by the work of International Cartographic Association (ICA) Commission on Visualization and Virtual Environments[17] in developing a comprehensive geovisualization research agenda (see Dykes *et al.* 2005). Leading proponents of 'representation' paradigm, MacEachren and Kraak (2001, 4) argued geovisualisation's agenda should be focused on supporting researchers dealing with data-rich human-environment problems, to "provide 'windows' into the complexity of phenomena and processes involved, through innovative scene construction, virtual environments, and collaboration, thus prompting insight into the structures and relationships contained within these complex, linked datasets." Key issues of concern were providing map-based visualisation tools that could be distributed amongst diverse research teams and used in group working tasks; research into three-dimensional representations and immersive modes of interactions (the 'fly-thru-map'); along with empirically driven work on evaluation and usability of these software tools. In evaluating geovisualisation, the concern has been on the fidelity of representation (often with a concern for mimetic 'reality'), issues of scale and level-of-detail on cognitive perception and the potential of 2d-to-3d transformations and linked representations to expose novel spatial data relations. There are also growing linkages with other innovations in representing non-geographic data using spatial metaphors in the field of information visualisation (see Skupin and Fabrikant 2003). Although the map as a graphic image is central to the geovisualisation paradigm, there are also wider concerns with facilitating analytical methods within a visualisation environment (such as interactive parameter testing in spatial statistics and simulation modelling). This concern overlaps heavily with the development of GIScience. Whilst distinctly positivist epistemologies underlie the geovisualisation paradigm, some have tried to open up the scope of visualisation in more politically progressive directions, for example Kwan's (2002; 2007) work in fusing geospatial technologies with feminist theory to map affect and emotional geographies.

[17] Commission's homepage at <http://kartoweb.itc.nl/icavis/index.html>.

Many of the most interesting developments in cyberspace cartographies have clear linkages and overlaps with developments in geovisualisation, in terms of using interactive spatial representations – the 'map' – as an interface tool for data exploration and knowledge discovery. Developing new forms of interface and interaction that let the analyst explore and cognise cyberspace in terms of spatial patterns and semantic relationships that are not readily apparent in the raw data (very often large databases of automatically logged records); for example, the visualisation of Internet infrastructure by three-dimensional geographic visualisation of network address ownership (Shiode and Dodge 1999).

2.3.3 Cartography as power

> Robinson tried to describe how maps are, whereas Harley asks why maps are as they are, and how else they can be. It is this latter project which is the political one. (Crampton 2002, 15)

> No sooner are maps acknowledged as social constructions than their contingent, their conditional, their ... arbitrary character is unveiled. Suddenly the things represented by these lines are open to discussion and debate, the *interest* in them of owner, state, insurance company is made apparent. (Wood 1992, 19)

Cartographers would agree that all maps are, by necessity, selective and that all maps are designed to serve particular purposes. This somewhat innocuous admission, however, can - depending on the philosophical position one holds - lead to a significant re-interpretation of the nature of mapping. In the last fifteen years or so, a new strand of critical cartographic theory has emerged, which takes a fundamentally different viewpoint as to what is the purpose of maps is and the social significance of human agency in map-making. The thrust of this perspective is twofold: first, the acknowledgement that the map is a form of power-knowledge, and second, the rejection of the cartographic orthodoxy of representational objectivism and communicative efficiency. The concern of this paradigm, as Crampton alludes to in the quote above, is not to accept normative cartographic discourses, but to "subvert the apparent naturalness and innocence of the world shown in maps both past and present" (Harley 1992, 232).

Scholars advocating a critical theory concerning the 'power of maps' argue that maps are social constructions that reflect the ideological structure of their production and work actively in the ongoing reproduction of these structures. Maps are never neutral 'scientific' representations, instead they are powerful heuristic devices serving particular interests. Furthermore, the consequences of what Wood (1992) conceptualises as the 'interested selectivity of cartography' flow well beyond the semiotics of the map image itself. These consequences of map power on human lives have been largely overlooked by earlier academic cartography discourses focused on design and technique. To reverse this, critical scholars sought to bring concerns for cultural, social and ethical issues into the centre of the academic cartography discipline. Indeed, strident advocates of critical cartography view the map with suspicion, seeing it as a hegemonic object in struggles for social domination, and regard cartographers as guiltily implicated in the production of social difference (such as governance of populations, enforcement of property rights, imperial conquest and colonial exploitation, and military violence and environmental destruction). Mapping for them is a deeply politicised process.

The socially constructed nature of contemporary cartography itself is not readily apparent because the reader shares, often at the subconscious level, much the same values as the map-maker. Most conventional map representations are 'in-step' with norms of the society in which they are made, agreeing on what is and is not important in that socio-political milieu. Occasionally, however, the map-maker's social values will be at odds with the reader's, so that the map will be viewed as unconventional or controversial (e.g., Bunge's (1975) maps from the Detroit Geographical Exploration or CCTV maps produced by the New York Surveillance Camera Players[18]). Similarly, maps from earlier historical periods, when viewed from the perspective of contemporary cultural norms, often seem 'wrong' (people can see them as social constructions). Contemporary politically-

[18] See <www.notbored.org/scp-maps.html>.

motivated counter-mapping[19] projects set out to produce maps that reveal 'truth' by deliberately unsettling the pact of shared social values between reader and map-maker.

To begin to understand the politics of cartography, advocates of the 'power of maps' paradigm argue, one must 'deconstruct' and 'demystify' the implicit and explicit power relations imbedded in the representation, questioning why the map was made, who paid for it to be made, exposing who gains from the map, and, equally, who loses from the map's work in the world; it is necessary to expose what point-of-view the map takes while it assiduously pretends to be a 'view from nowhere'. Harley (1992, 232), set out in his methodological agenda to, "show how cartography also belongs to the terrain of the social world in which it is produced. My key metaphor is that we should begin to deconstruct the map by challenging its assumed autonomy as a mode of representation."

The critical paradigm emerged in academic cartographic research, particularly from the sub-discipline of the history of cartography, in the late 1980s, propelled in large part by the influential work of Brian Harley and Denis Wood. It can seen as following along with a much broader critical 'project' across the social sciences, focused on rethinking the nature of representations within contemporary visual cultures. Harley, and other cartography theorists, drew on a range of poststructural ideas to question the Cartesian surety of the map as a 'natural' representation of reality, particularly the influential work of the social theorists, Roland Barthes, Jacques Derrida, and Walter Benjamin in analysing texts, sign systems and the political economy of images. Besides such textual deconstruction, other concepts have been drawn from feminism (particularly the work of Donna Haraway) and governmentality (especially the work of Michel Foucault). Critical ideas on the politics of mapping have informed a number of

[19] Counter-mapping is the conscious deployment of maps to exploit the authority embedded within cartographic representation to challenge established power relations. As Peluso (1995, 387) argues in relation to struggles over natural resources in Indonesia, "[c]ounter-maps ... have the potential for challenging the omissions of human settlements from forest maps, for contesting the homogenization of space on political, zoning, or property maps, for altering the categories of land and forest management, and for expressing social relationships in space rather than depicting abstract space in itself." See also, Aberley (1993) and Harris and Hazen (2005).

substantive, theoretically-driven 'archaeologies' of cartographic knowledges in specific geopolitical contexts[20].

The 'crisis of representation' as it pertains to maps, seeks to undermine the truth claims of mainstream 'scientific' cartography in at least three ways. Firstly, it questions modern (Western) science's privileging of representations of real-world phenomena based on empirical observation, overlooking the social and cultural conditions within which such observations are grounded. Fundamental to this privileging is the ontological dualism of observer and subject, which is replicated in cartography as the separation of the map from the territory it represents. As Edney (1993, 54) put it: "[t]here is a world of geographic facts 'out there' - separate and distant from the observer - which are to be 'discovered' by the explorer and surveyor". If there are errors in the map, these are technical and do not effect the representational essentialism of cartography, i.e., maps can capture faithfully the details of the landscape, they are 'mirrors of nature' (Rorty 1980).

Secondly, critics dispute the possibility of producing 'mirrors of nature', arguing in many ways that the map *precedes* the territory. As Pickles (2004a, 145) asserts: "[f]ar from being a mere representation of private property, cadastral mapping gave legal and material form to the new territories and landscapes of private property".

Thirdly, the fallacy of modern representationalist logics has been highlighted by alternative measurement methodologies. From a philosophical point of view, the application of fractal analysis to geographic features, for example, breaks the faith in being able measure 'facts' with certainty. Benoît Mandelbrot's (1967) simple question about 'how long is the coastline of Britain?' exposed the scale-dependent nature of capturing cartographic data. While the increasing diversity

[20] Examples include: Schulten's (2001) in-depth study of U.S. mapping institutions, focused on popular world maps and atlases produced by Rand McNally and National Geographic, and their role in the social construction of modern American geographical imagination; Edney's (1997) detailed study of British colonial mapping in India; Winichakul's (1997) examination of the role of cartography in the construction of national identity of nineteenth century Thailand; Herb's (1997) reading of map use in Weimar and Nazi Germany.

of data sources, from surveys, sensors, and satellite imaging, means the appearance of empirical unity and universality in state-produced topographic representations dissolves. The ease with which aerial photographs can now be directly compared to topographic maps, using for example Google Maps, is powerful exemplar (Dodge and Perkins 2008b). Ultimately, the technologies of cartographic measurement are dialectical. As Turnbull (2004, 209) argues: "Our devices for measuring the world frame our understanding of nature but cannot by themselves lead to greater correspondence with reality, rather they require the proliferation of evermore sophisticated technical devices and social strategies to keep our conceptions and nature in line."

The focus of critical cartography deconstruction has been principally historical in character, rather than focused on contemporary mapping practice (although, see Pickles 2004a, chapter 8). There has been little published research that has applied the 'power of maps' theoretical perspective to begin to understand the ideologies of cyberspace cartographies (although, see Crampton 2003, chapter two; Dodge and Kitchin 2000b; Harpold 1999).

While this body of critical writing on cartography has been forceful (and sometimes polemical), it is not without its problems, inconsistencies and critics (e.g., Andrews 2001; Belyea 1992; Godlewska 1989). Keates (1996, 194), for example, undermines the methodological agenda of Harley and 'critical cartography' paradigm more broadly, commenting: "The question of how the production and publication of maps is controlled in any society is an interesting and important issue, but it is not illuminated by uttering clichés about hidden agendas."

Ideologically-driven cartographic deconstruction can also be seen as unproductive in that it offers little in the way of an agenda for map-making *practice* to carry forward (Crampton 2001; Kitchin and Dodge 2007). Indeed, the influence of new critical theoretical approaches within academic discourse is in marked contrast to the work of the large majority of cartographers in practitioner communities, in university drawing offices, in government departments and in commercial design firms. The profession has not followed this new epistemological line as it offers little of value for those tasked with real world demands of making effective maps[21] and they have little reason to contribute to theoretical debates; as Petchenik (1985, quoted in Keates 1996, 190) wryly notes: "Practising cartographers tend to be so busy earning their living by making and selling maps that there isn't 'free' time or energy left to be expended on research and writing projects: as a consequence, their point of view is not accurately reflected in the literature." Equally disappointing in terms of effecting progressive change in the nature of cartography is the failure of human geographers to make critical *use* of maps in their researches. Accordingly, Perkins (2004, 385) laments: "[d]espite arguments for a social cartography employing visualizations to destabilize accepted categories most geographers prefer to write theory rather than employ critical visualization". The humanistic cartography of Dorling, discussed below, is a notable exception to this (the Worldmapper cartograms project he leads has enjoyed considerable success; also Dodge and Kitchin 2008a).

Other accusations levelled at critical cartography include: a misreading and superficial misusing of social theories, of simply jumping on the cultural 'bandwagon' of deconstruction and the foisting of a false 'conspiracy' view of cartography through biased sampling of empirical evidence (Black 1997). "In contrast to Harley's experience of cartographers", Godlewska (1989, 97) notes, "I have found that most have a subtle and critical sense of the nature of their work and do not perceive cartography as an objective form of knowledge". Of course, the critical scholars themselves had an agenda in their attacks on mainstream cartography, being "propelled by an odd mixture of cynicism and idealism" (Lemann 2001, no pagination).

It is also worthwhile noting, that besides the ideologically-driven 'deconstructionists', this paradigm includes other socially-informed and progressive scholarship. One might term this work 'map scepticism' rather 'map

[21] Much the same situation pertains to the case of GIS research and the 'Ground Truth' debate (cf. Schuurman 2000).

criticism'[22]. It is significant work, I think, as it has tried to move mapping *practice* forward in addition to commenting on the politics of map-making. The position is highlighted best by Monmonier's empirically-informed works which consistently pointed up the social implications of mapping across a range of pertinent topics. His work is also valuable as it is consciously written to reach beyond the confines of academia to inform a wider readership. In addition to Monmonier, the work of quantitative social geographer Dorling (1995; 1998) is noteworthy in questioning conventional statistical mapping practices and also offering up a range of alternative, more 'democratic' visualisation techniques (especially the use of cartograms). Dorling (2005), for example, produced socially-informed mapping applicable to educating the next generation of geographers and also to influence public policy by more effectively highlighting the extent of social inequalities across space; "[m]aps are powerful images", acknowledges Dorling (1998, 287), but this can be exploited in a progressive way, "[f]or people who want to change the way we think about the world, changing our maps is often a necessary first step".

2.3.3.1 Three levels of map 'deconstruction'

In terms of undertaking a deconstructive type of interpretation of cartography, it is useful to think of the process as working on three levels: 'power on the map', 'power in the map' and 'power through the map'. We consider each level in turn.

- 'Power on the map'

"Maps are stories we tell about ourselves, but they are stories with political payoff" notes Crampton (2004, 41) and "the question for map criticism is then to expose who is getting the payoff and how it is achieved." To begin this work, one needs to focus on the power exerted on the map in its production. Maps are embedded within a relational network of power/knowledge. The map-maker is not a lone individual or organisation, but encompasses a whole set of actors - explorers and surveyors, designers and printers, publishers and politicians - all with interests and particular agendas working in ongoing processes. The map

[22] This kind of realist conceptualisation of cartography as an imperfect enterprise has a longer pedigree of course, for example dating back to J.K. Wright's 1942 paper, *Map makers are human: comments on the subjective in maps.*

necessarily emerges from this milieu, as a codified and conventionalised text that stabilises the network into visual form at a particular point in time. Within the network geometry of the map's production there are unequal relationships, with much power resting on the patrons (be they the military, local government, commercial firms or the patronage of kings and princes of times past)[23]. The power exerted in the network of cartographic production leave visible traces, to varying degrees, in the actual content and graphic form of map text itself. Power resides within the map's image. Critical analysis seeks to reveal the traces.

- 'Power in the map'

The application of epistemological tools from social theory can provide a new reading of map artefacts as texts. This analysis looks beyond the aesthetic connoisseurship of the map collector or the Tufte-type rules of good design and focuses on the 'second text' of the map. As such, deconstructing the map means exposing the reasons underlying the selectivity of what is displayed and demystifying the origins of the signs used. This focus has clear links to semiotic concern for connotative meanings examined by the 'representation' paradigm.

Everything about the look of a map is subjective and to some extent arbitrary in semiotic terms, but people usually ignore this because they read modern maps as 'natural', having been thoroughly indoctrinated into the conventions of cartographic sign systems (i.e., a blue line for a river)[24].

The power in the map text through the conventionality of sign systems can be deconstructed in terms of 'rules of cartography' (Harley 1992). These rules enable certain map texts to be conceived and made, whilst at the same time making other maps unacceptably unconventional and, therefore, unmade. The rules are generally not openly acknowledged and many operate in unspoken and unconscious ways (i.e. 'this the way we always represent churches'). Traditions,

[23] When talking critically to individuals at Ordnance Survey (the epitome of professional map-makers in many respects) one often discovers the severe limits on their freedom of action in terms of what gets mapped and what is left unmapped by the 'government'.

[24] Furthermore, as noted by Board, the "very existence of conventions allows the 'counter-mapper' to shock by breaking with conventions." (Source: Chris Board, PhD examiners report, 24th October 2006.)

customary working practices, professional standards, institutional cultures, all help to simultaneously mask the rules and enforce the rules, as well as ensuring their perpetuation. The ways of 'policing' the rules become more overt, with external threats (the reaction by some in the mapping 'establishment' to the Peters projection and his agenda, for example; cf. Vujakovic 2002 for discussion and sources). Even though these rules are very powerful, they are never universal and are also contingent on the time and context of production. Such rules also provide opportunities for resistance by exposing their conventionality.

Harley (1992) advances two exemplars of these subtle yet powerful cartographic rules: the 'rule of ethnocentricity' and the 'rule of social ordering'. The first rule is premised on the tendency for any society to place itself (its territorial base or metropolitan heartland) at the centre of its maps, thereby, granting more significance to itself and 'pushing' other peoples and places to the periphery. The subliminal geometry of the map image is used to achieve this. For example, it is evident in the choice of orientation and projection used on world maps. Eurocentric dominance in cartography means a map of the world conventionally centred on the Atlantic, with north at the top. While Mercator 'biases' in relative apparent sizes of nations are long-lasting in the cartographic imaginary and as Stewart (1943, 589) noted more than sixty years ago: "Children studying elementary geography should be warned that a Mercator map of the world, .. is *not* a picture but a representation in code; specifically, the 'Mercator code'." Breaking the convention on world maps (such as 'upside down' projections like McArthur's Universal Corrective Map) shows just what a powerful hold the 'rule' of Eurocentricism has on cartography.

In the second rule, the sign systems employed on maps encode an implicit hierarchy of space based on social power rather than objective measures of importance. So, the "distinctions of class and power are engineered, reified and legitimated by means of cartographic signs" (Harley 1992, 237). The palace, cathedral, and castle have, historically, been most prominently represented on maps because they are classified as socially significant (i.e. powerful). The rule of thumb is that the more powerful you are, the more visible you will be on the map. A stark example of this is the urban mapping in apartheid South Africa, where small typefaces were used to label large black townships, while much larger, more prominent labels were used to show white settlements which often had far fewer inhabitants (Stickler 1990). However, there are many other more subtle examples, such as the prioritising of mapped landscapes for car drivers in almost all general cartography, at the expense of other forms of mobility (Perkins and Thomson 2005).

Another important concept elaborated by Harley (1988b) to deconstruct the power in the map was the theory of cartographic silences. The idea that what is *not* shown on a map can be as revealing to the implicit agenda as what *is* shown. The absence of a feature on a map that one would normally expect to see (i.e. it is technically possible to survey and represent it at the nominal scale of the map) is read as a *positive* statement in the mapping process, rather just a passive gap in representation. There is a range of intentional and deliberate silences, where geographic information is suppressed and censored from maps - often, due to strictures of security or exigencies of commercial confidentiality. So, for example, certain military bases and security installations in the UK have been absent or masked on successive official maps (cf. Board 1991; Hodson 1999), even though they are evident on aerial photographs (Dodge 2004). Increasing fears of terrorism following 9/11 have led to a much wider definition of 'sensitive sites', including various infrastructure networks, and the 'chilling' of previously published map information on these (see Zellmer 2004 for the perspective of map librarians).

Beyond such wilful censorship there is a range of subtle and insidious silences that operate as a 'hidden' rule. Certain aspects of the material landscape of society are silenced because they are not appropriate – they are 'not the things we put on our maps'; "objects outside the surveyor's classification of 'reality' are excluded" (Harley 1988b, 65). These objects might be inconvenient, embarrassing or deemed insignificant and are made to disappear figuratively from the map. The active denial of indigenous place-names on colonial cartography or the erasure of politically-incorrect toponynms on official maps are examples the power of silencing (cf. Monmonier 2006) .

- 'Power through the map'

The power relations encoded semiotically within the map text do not exist in isolation, they (re)project outward from the image onto the space and social lives they purport to represent. The map can create power itself - just like the power of a photograph, film or song - by changing opinions, stirring the emotions and inspiring and enabling action in the world. As such, cartographic knowledge has often been jealously guarded because it is perceived to be so powerful (Harley 1988b).

"Cartographers manufacture power: they create a spatial panopticon" (Harley 1992, 244) and use of official cartography, according to critical deconstructionists, demonstrates that the map to be a pre-eminent device of social domination by manufacturing not just visibility over space but also legibility throughout the social-material landscape, "rendering the broad swathes of worldly complexity and enormity in miniature form for a discrete purpose" (Pickles 2004a, 80). Hegemonic power exercised through the map is evident in the conduct of wars, the delineation and enforcement of property rights (at all different scales), for counting and monitoring population, and maintaining law and order. The instrumental role of government mapping in European imperial exploitation through the erasure of indigenous peoples from the colonisers' maps provides strong evidence of exercise of power through cartography. In the partition of India, the annexation of Palestinian land or the '*terra nullius*' of Australia, cartography has been integral to colonial practices, providing both spatial justification and a rationalising tool for colonisers, past and present. For example, Bassett's (1994, 333) analysis of maps made by European imperial powers at the end of the nineteenth century demonstrates how effectively they "promoted the appropriation of African space under the rhetoric of commerce and civilization."

An important way that the power of the cartography works in the world is by dehumanising the landscape, allowing powerful groups to exercise power at a distance, "removed from the realm of face-to-face contacts" (Harley 1988a, 303). Maps are foundational to modern systems of governmentality, as evidenced in the extensive use of statistical mapping by bureaucracies and businesses (see examples related to Internet in chapter five and appendix two). Maps have come to actually symbolize the governmental processes of regimentation, in which people and places are rendered as mere dots. This kind of de-socialisation of space through cartographic abstraction is seen most brutally in the military. Modern war making is now frighteningly like a game played out on digital map interfaces that render human landscapes into an impersonal terrain of targets and threats that can be engaged by so-called precision-guided weapons (cf. Vujakovic 2002a).

Beyond war fighting, states also actively uses cartography to foster national identity and legitimate the sovereignty over territory (cf. for European nations, Vujakovic 1995 and 1999b; for Finland, Kosonen 2008; for the U.S., Edsall 2007). The map provides one of the most potent images of unity between people, territory and the government (Biggs 1999). Anderson's (1991, 175) thesis of nationalism as imagined community, for example, highlights the extensive symbolic power of 'map-as-logo', deployed in an "infinitely reproducible series, available for transfer to posters, official seals, letterheads, magazine and textbook covers, tablecloths, and hotel walls. Instantly recognisable, everywhere visible." Maps showing the world divided geopolitically have become so ingrained as 'natural' template that such borders are present even in maps which are not explicitly political (e.g., weather maps). (See also discussion in chapter five on the connotations arising from the use of nation state as the mapping template for representing the Internet.) The symbolic power of cartography to make borders is endlessly exploited in the 'grand games' of geopolitics between states, including Halford Mackinder's cartographic articulation of the 'Eurasian heartlands' thesis at the height of British imperial power (Mackinder 1904).

The myriad ways that the state has come to rely on 'power through the map' to govern means that it is far and away the largest patron of cartography, but mapping is also integral in the processes of capitalist accumulation by (re)ordering lived lives into markets, potential markets or obstructions to markets. For example, geodemographic mapping reductively profiles individuals, fitting them into idealised consumer types, fixing them into a spatial grid of quantifiable economic value and ranking them based on 'worth' or 'risk' (see

Curry 1997; Goss 1995). This easily leads to discriminatory practices of 'redlining' - the term is derived from the mapping practice - where whole communities deemed unprofitable or high risk and are denied services (e.g., see Hillier's (2005) historical analysis of mortgage loan discrimination in Philadelphia).

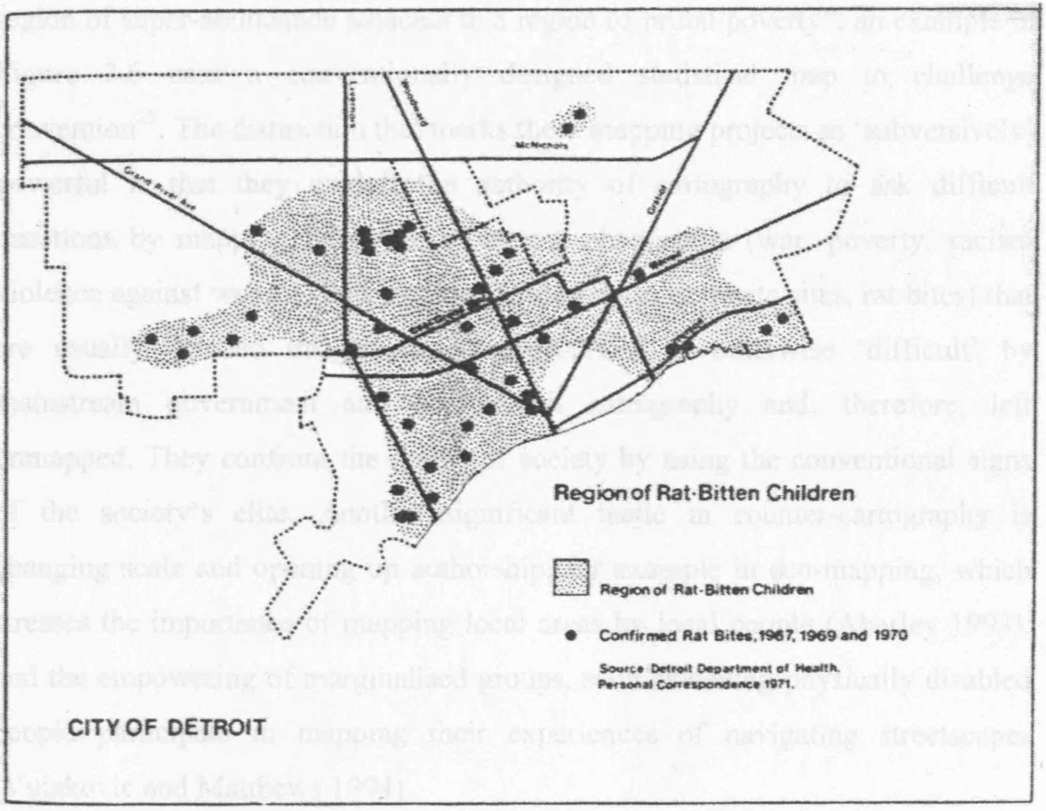

Figure 2.6: Example of the counter-cartography of William Bunge showing the rhetorical power of thematic maps to challenge the status-quo. (Source: author scan from Bunge 1975, 161.)

The potent role of cartographic power in social domination by states and corporations is certainly strong, such hegemonic mapping is also dialectical because it always opens up ways to resist. The practical and rhetorical power of maps to articulate alternative perspectives is always available. The power of the map can be used to re-frame the world in the service of progressive interests and to challenge inequality (such was the overt goal of the Peters projection project), while the logo-map used to bolster the state can re-imagined as a potent emblem in anti-colonial struggles (Huggan 1989). Cartographic power has also been exploited by environmental pressure groups and anti-globalisation activists to counter the dominant corporate discourses, usurping the authority of the map against hegemonic interest (e.g., 'scientific' maps of the global temperatures and shrinking ice sheets have become potent images for climate change campaigners). This kind of counter-hegemonic cartographic potential was evident in the work of radical geographer Bunge (1975, 150) and his expeditionary geography, mapping socially-polarised urban America, to "depict a region of super-abundance adjacent to a region of brutal poverty"; an example in Figure 2.6 uses a conventionally designed statistical map to challenge convention[25]. The distinction that marks these mapping projects as 'subversively' powerful is that they exploit the authority of cartography to ask difficult questions by mapping the types of human phenomena (war, poverty, racism violence against women) and landscape features (toxic waste sites, rat bites) that are usually deemed insignificant, inappropriate or otherwise 'difficult' by mainstream government and commercial cartography and, therefore, left unmapped. They confront the norms of society by using the conventional signs of the society's elite. Another significant tactic in counter-cartography is changing scale and opening up authorship, for example in eco-mapping, which stresses the importance of mapping local areas by local people (Aberley 1993), and the empowering of marginalised groups, such as having physically disabled people participate in mapping their experiences of navigating streetscapes (Vujakovic and Matthews 1994).

2.4 Conclusions

In conclusion, one might ask to what extent can the ideas from the 'map as representation' and the 'power of maps' paradigms be productively applied to cyberspace cartographies? To answer this, I would argue, firstly, that ideas on semiotic interpretation from the 'representation' paradigm can highlight the conventional notions that underlie much cyberspace mapping and lead to analytical insights on the partial nature of new maps, and the contested social

[25] Vujakovic (notes on thesis draft, October 2006) observes that Bunge also uses deliberate cartographic design "slight of hand" in terms of widely extrapolating the extents of the rat-bite area from a sparse distribution of data points.

meanings of the map signs, the wider social milieu in which they are embedded, and how they work as cartographic imagination shaping the perception of cyberspace for users.

Secondly, that concepts from the 'critical cartography' paradigm can and should be connected to understanding these new modes of mapping, not least because the hegemonic work of cartography is being replicated to a large degree in cyberspace. The luxury of hindsight and the distance of time seem to make the political agendas and social consequences of old maps more apparent, but there is a need to critically read contemporary maps because they are the ones directly affecting people's lives today. Many of the implicit purposes of today's maps of cyberspace are the same as those of maps from earlier times – to control space and exert sovereignty, to legitimate private property rights, to surveil people, to defend social difference, to make a profit. The theoretical ideas, such as rules of ethnocentric geometry and social ordering, the concepts of mapped silences, spatial governmentality and dehumanisation through cartographic abstraction, along with the focus on authorship and contested practices, can open up cyberspace cartographies critically and as shown in the empirical analysis presented in chapters five and six help reveal the ideology of the maps of Internet infrastructures.

Chapter Three

Cyberspace Cartographies

> [N]ow we have the emergence of cyberspace ... It is largely invisible to conventional methods of observation and measurement ... We need to begin to map this space, to visualize its architecture, and to show how it connects to and transforms our traditional geographies. The task before us is urgent, baffling, and exciting...
>
> -- Michael Batty, *The Geography of Cyberspace,* 1993.

> The mapping of that vast territory known as cyberspace has begun in earnest ... They range from glorious depictions of globe-spanning communications networks to maps of Web information. Many have no geographic references, instead turning to nature, the cosmos or neuroscience for spatial models.
>
> – Pamela Licalzi O'Connell, *Beyond Geography: Mapping Unknowns of Cyberspace*, 1999.

3.1 Introduction

A major part of my interest researching cyberspace cartographies has been to learn about the authorship of the new map representations produced outside of the mainstream mapping industry. Who are the new map-makers and what motivates them to tackle the challenge of mapping aspects of cyberspace? Over the past thirty years many different map-makers, from a diverse range of academic, technical and institutional backgrounds, have mapped different aspects of cyberspace. It is apparent that cyberspace cartographies are one of the significant areas of creativity in map-making, with a considerable amount of experimentation with new visual metaphors, new survey methods and data sources, and above all new forms of users interaction with map artefacts. Indeed, as cyberspace is lacking established conventions of representations, it is a domain ripe for real cartographic innovation, along with opportunities for counter-hegemonic and 'bottom-up' mapping activity outside of established institutional boundaries. As such cyberspace cartographies need to be studied in greater depth.

This chapter, therefore, begins by offering a substantive review of cyberspace cartographies using a three-fold classification of mapping modes identified in the introduction. This is followed by a review of relevant theoretical literature focusing on how other scholars have defined the domain of cyberspace cartographies and the issues implications they highlight. The review also considers the more significant media reporting of the field revealing how these new mapping modes have been presented to the general public.

3.2 Cyberspace and new modes of cartography

The cartographic imagination in Europe was profoundly changed during the 'age of discovery' in the fifteenth century as the bounds of geographic knowledge expanded. Now, at the digital 'fin de siècle', a new and diverse range of mapping activities has emerged in concert with the so-called 'age of information', giving rise to new cartographic imaginings encompassing cyberspace. As discussed in chapter two there are a range of ways to theorise such cartographic change and innovation and here I follow Edney's (1993, 54) non-progressive genealogical approach in which map-making is composed of a number of *modes*, that are historically contingent sets of "cultural, social, and technological relations which define cartographic practices and which determine the character of cartographic information". Modes of cartographic practice are coupled to the continual emergence of new knowledges, problems, methods, and institutions, driving developments in both the design of map representations and roles that cartographic artefacts serve in society.

Contemporary mapping practices for the information age - what I term cyberspace cartographies - can be categorised into three distinct modes:

- maps <u>in</u> cyberspace,
- maps <u>of</u> cyberspace,
- maps <u>for</u> cyberspace.

The first mode, 'maps in cyberspace' involves putting existing forms of terrestrial cartography online to widen access and add user interactivity. Whilst somewhat more prosaic than the other two modes, work in this area to distribute existing map information in new ways, and to new audiences, has undoubtedly had the widest impact on the discipline of cartography (e.g., many millions of people use Web mapping services daily to create custom maps). Maps in this mode are characterised by their spatial conception based exclusively on conventional geographic frameworks. In institutional terms, the established cartographic industry is at the centre of these developments (although being challenged by new players, e.g., Google Maps).

The second mode of 'maps of cyberspace' is focused on mapping that describes the structures of networks and documents the operations of cyberspace itself, as viewed from external positions. In some senses they can be thought of as the engineering and thematic maps of cyberspace infrastructures and customer statistics. (As already noted, this thesis is focused on this mode through the analysis of two different genres of Internet network infrastructure mapping, of network routes and national connectivity statistics) The scope of this mode is, therefore, primarily defined by the subject of the maps rather than the spatial conception of the map representations or the tasks undertaken with them. The resulting maps encompass a multitude of graphic forms, some of which appear quite un-cartographic in a normative sense, such as topological network graphs and abstract flow diagrams (see discussion in chapter four on spatial metaphors to envision Internet infrastructure).

The last mode produces maps for navigating through cyberspace, their purpose is to guide users within the virtual spaces themselves. They are mostly created through the spatialization of non-geographic information structures to produce a visual map-like interfaces to virtual space that can support interactive browsing and searching. As such this mode is primarily defined by the task to which the maps are put rather than their subject or spatial conception. Many of the maps from this mode are experimental interfaces and produced in different institutional contexts to the other modes, particularly academic computer science and commercial software research laboratories, as well as more expressive and experimental work from new media artists.

The formal nature, and wider cultural meanings and social implications, of these three modes of cyberspace cartography is a novel area for scholarly research. It has received relatively little consideration within academic cartography and geography (although, the 'maps in cyberspace' has been subject to a sizeable amount of analysis, but this tends to be technical rather than conceptual or political). While this framing of cyberspace cartographies into three modes is an imposed classification and somewhat artificial, I think it does provide a useful conceptual aid to analysis. It is useful to try to group social-technical innovations into a new modes to see the overlaps between them, to identify the distinctive themes (in terms of 'what' to map and 'how' to map it) that divide them, and to mark out their particular relationships to wider 'information age' discourses (e.g., the pluralism of authorship and open content versus enforced marketisation and the greater corporate control; enhanced activism and transparency versus increased securitisation and the rise of the 'fear economy'; strengthening of localism and regional diversity versus deepening cultural globalisation and homogenising consumption patterns).

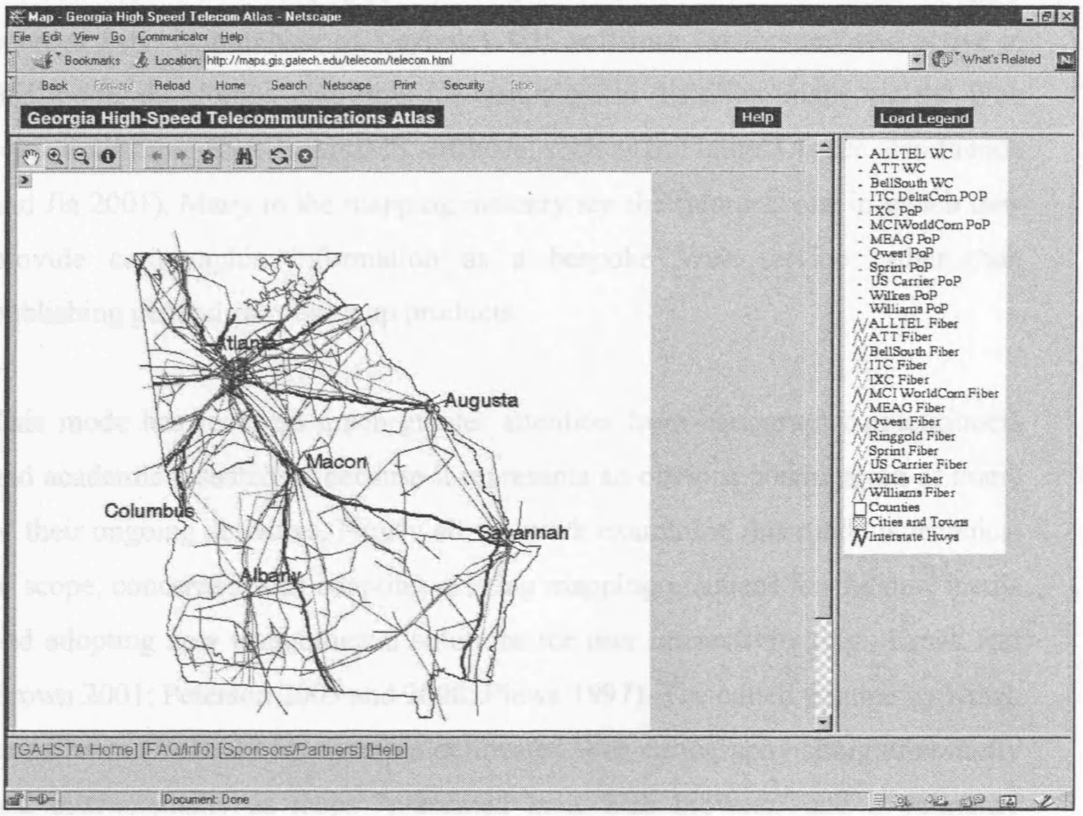

Figure 3.1: Telecommunications atlas of network infrastructure in Georgia, USA is an example of 'maps of cyberspace' mode based on it thematic interest and was disseminated using Web mapping technology that is more characteristic of the 'maps in cyberspace' mode. (Source: Center for Geographic Information Systems, <http://maps.gis.gatech.edu/>, no longer available online.)

3.2.1 The 'maps in cyberspace' mode

The work in this mode has already produced demonstrable utility and commercial viability in putting 'real-world' cartography online through developments in Web mapping portals and Internet-based GIS services. Much of the innovation in this mode has links into the visualisation research in the representation paradigm, however, the large-scale deployment is very much commercially driven, often through joint ventures between established mapping organisations and newer Internet-focused companies with e-commerce experience (e.g. Google launching its impressive online mapping service in the summer of 2005 with topographic data primarily from Tele Atlas and imagery sourced from its purchase of Keyhole). GIS software vendors are also active in this mode, developing platforms for customers to distribute maps via the Web (e.g., built using ESRI's ArcIMS software, such as in Figure 3.1; see also French and Jia 2001). Many in the mapping industry see the future as one in which they provide cartographic information as a bespoke Web service rather than publishing general-purpose map products.

This mode has received much greater attention from cartography practitioners and academic researchers because it represents an obvious continuation of many of their ongoing activities. Nearly all the work examining this mode is technical in scope, concerned with adapting existing mapping practices for the new media and adopting new technological solutions for user interactivity (e.g., Kraak and Brown 2001; Peterson 2003 and 2008; Plewe 1997). The edited volume by Kraak and Brown (2001, 1) for example delineates Web cartography straightforwardly and instrumentally as maps "presented in a Web browser" and is primarily concerned with design and presentation issues in relation to the constraints and opportunities of the new medium of publishing. Two notable exceptions to the focus on the 'engineering' side are Crampton's (2003) useful genealogical analysis of distributed mapping and Monmonier's (2002) consideration of some of privacy implications of making cartographic information widely available online.

One of the more sophisticated research efforts to understand this mode of cartography is led by Taylor and colleagues at Carleton University in Canada, under the project they call 'cybercartography' (Taylor and Caquard 2006). He argues that the Internet, as a new publishing media, is "revolutionising cartography" and that the map reconceived as an interface tool will be "key to navigation in the information era, as both a framework to integrate information and a process by which that information can be organized, understood and used" (Taylor 2003, 405). Their research agenda in many respects sets the techno-cultural imperatives underlying this mode of cartography, focuses on new multiple representation for maps and the media to deliver them. It comprises seven core elements aimed at creating new maps which:

- are multisensory (vision, sound, touch and leading to smell and taste),
- are multimedia format, exploiting new media,
- are highly interactive and engage users in new ways,
- are applied to a wide range of topics of interest to society,
- are integrated with analytical capability rather than a 'stand-alone' products
- are compiled by teams of individuals from different disciplines,
- involve new research partnerships among academia, government, civil society and the private sector.

(following Taylor 2003, 407).

The agenda is clearly building upon a communicational view of cartography with the focus on designing better map artefacts for representing data about geographic spaces rather than as an immersive navigation tool for information space (hence it should be seen as distinctive from the third mode of cyberspace mapping, 'maps <u>for</u> cyberspace'). If this research agenda is achieved - and much is being actively pursued by geovisualisation researchers (cf. Dodge *et al.* 2008; Dykes *et al.* 2005) - the nature of mapping as experienced by a general audience will likely be profoundly changed in the next decade. One might argue that Google Earth is already delivering much of this.

3.2.2 The 'maps <u>of</u> cyberspace' mode

A functional definition of the 'map <u>of</u> cyberspace' mode is any visual image that facilitates the spatial understanding of the physical makeup and operation of cyberspace itself. Their distinctive subject matter is to show what cyberspace 'looks like' by mapping how it is produced, revealing unseen details of its technical geography: infrastructure, operations and the patterns of customer activity. (See also chapter four on the role of spatial metaphors in this context.) There are overlaps between this mode of cyberspace cartography and the 'maps <u>in</u> cyberspace' mode outlined in the preceding section; for example, the commonality of practice and visual form in online mapping techniques used to display network routes (e.g., in interactive telecommunications atlases; Figure

3.1 above). One of the key denominators of the 'maps of cyberspace' mode from the other modes is, therefore, its thematic focus. Its 'external' descriptive approach distinguishes it from the 'maps for cyberspace' mode that are designed to be used 'internally' for searching and navigating online spaces.

The 'maps of cyberspace' mode encompasses a broad range of representational genres: cartography, abstract diagrams and charts and graph visualisations (chapter four details examples relating specifically to Internet network infrastructures; see also Dodge and Kitchin 2001). It is, therefore, difficult to taxonomise this mode based on graphic form or spatial conception of representations.

Many of the maps produced in this mode do look familiar in that they use semiotic conventions of mainstream cartography – for, example mapping the routes of cables as colour-coded line symbols on a generic geographic base map in the Georgia Telecommunications Atlas (Figure 3.1 above). A large proportion draw directly on the practices of thematic mapping to spatially represent statistical data on cyberspace's production, such as mapping telephone calling pattern (see Figures 3.2 and 3.3); chapter five analyses a series of conventional choropleth maps, produced at the world scale, to track the national diffusion of Internet connectivity and technological progress towards the 'information society'.

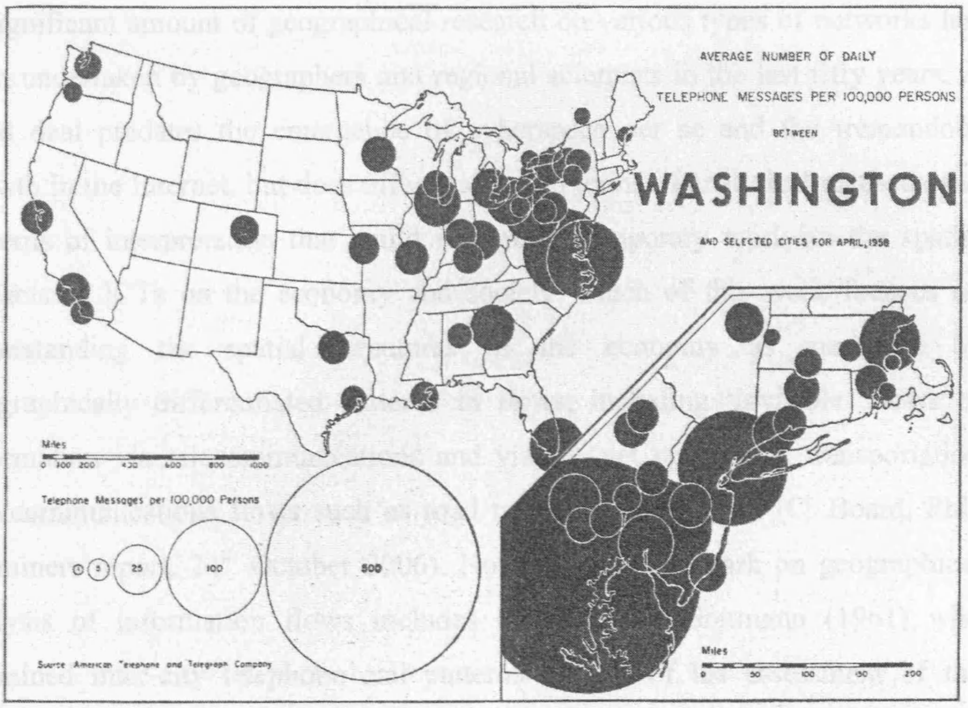

Figure 3.2: Statistical map of telephone calling patterns from Washington DC. This is a typical example of 'maps of cyberspace' mode presenting results of cyberspace census-taking in the context of academic analysis. (Source: author scan from Gottmann 1961, 593.)

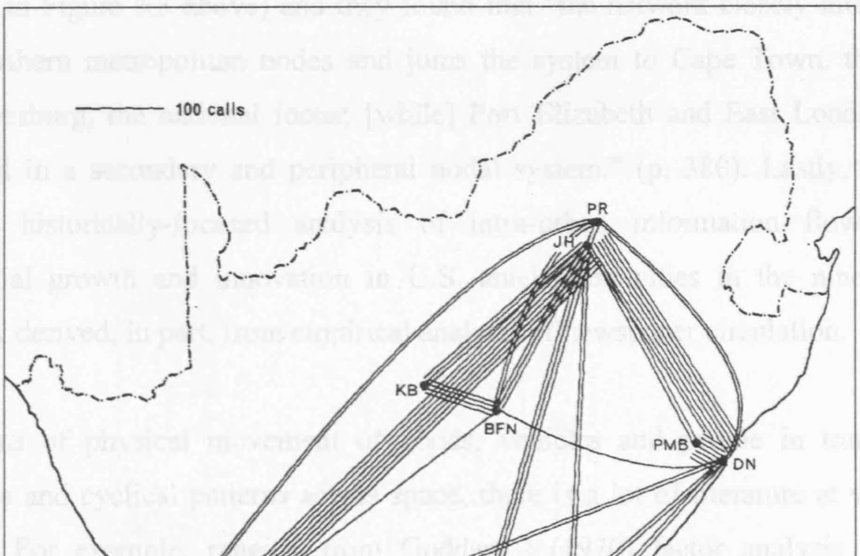

Figure 3.3: Statistical flow map of the volume of trunk telephone traffic between metropolitan centres in South Africa, 1963. (Source: author scan from Board *et al.* 1970, 381.)

A significant amount of geographical research on various types of networks has been undertaken by geographers and regional scientists in the last fifty years. A good deal predates the emergence of cyberspace per se and the tremendous growth in the Internet, but does offer insights in terms of analytical methods and patterns of interpretation that could inform contemporary work on the spatial impacts of ICTs on the economy and society. Much of this work focuses on understanding the spatial structures of the economy as measured by geographically differentiated patterns in flows, including 'invisible' flows of information via telecommunications and visible, yet ephemeral, transportation and communications flows such as road traffic or postal mail (C. Board, PhD examiners report, 24th October 2006). Noteworthy early work on geographical analysis of information flows includes the work of Gottmann (1961) who examined inter-city telephone call patterns as part of his assessment of the emerging 'informatisation' of the U.S. economy (example of the mapping produced is shown in Figure 3.2 above). Board *et al.* (1970) analysed telephone call statistics as one of a number of empirical variables in their integrative spatial analysis of the economy in South Africa (example of the mapping produced is shown in Figure 3.3 above) and they found that "the network closely integrates the northern metropolitan nodes and joins the system to Cape Town, through Johannesburg, the national focus; [while] Port Elizabeth and East London are isolated in a secondary and peripheral nodal system." (p. 380). Lastly, Pred's (1973) historically-focused analysis of intra-urban information flows and industrial growth and innovation in U.S. antebellum cities in the nineteenth century derived, in part, from empirical analysis of newspaper circulation.

In terms of physical movement of goods, vehicles and people in transitory patterns and cyclical patterns across space, there is a lot of literature at various scales. For example, ranging from Goddard's (1970) factor analysis of the movement economy of central London based on taxi flows, to Mitchelson and Wheeler's (1994) analysis of the aggregate patterns of inter-urban FedEx parcel deliveries to infer the hierarchy of U.S. cities; and up to global scale investigation such as Taylor (1999) and colleagues quantitative analysis of airline networks and passenger flows, as an element in their much larger empirical understanding of the systems of world cities, showing through network links how the major cities for chains and clusters of specialisation that underpins the global economy.

Tracing out more generalisable theories on spatial impacts of networks on society and the meanings embed in different kinds of flows and movements has tended to be dominated by other fields of social sciences than geography. The sociologists in the form of Manuel Castells, Anthony Giddens and John Urry seem to have been particularly successful in galvanising support for their ideas. An exception is the work of Ron Abler who has attempted to develop a general geographical theory relating distance to communication flows (cf. Falk and Abler 1980).

3.2.2.1 Representational forms

Other products of the 'maps <u>of</u> cyberspace' mode go beyond what many people would think of as 'maps' in their use of non-geographic forms of representations. For example, non-Euclidean visualisations of the topological structure of network infrastructures (e.g., Figure 4.10 in the next chapter). These abstract graphs focus on showing the connectivity between nodes rather than their position in geographic space. (In some cases such non-geographic visualisation is undertaken because of the difficulty in meaningfully and reliably geo-coding data objects, e.g. problems of locating Internet network addresses; see discussion in Grubesic and Murray 2005; Shiode and Dodge 1999).

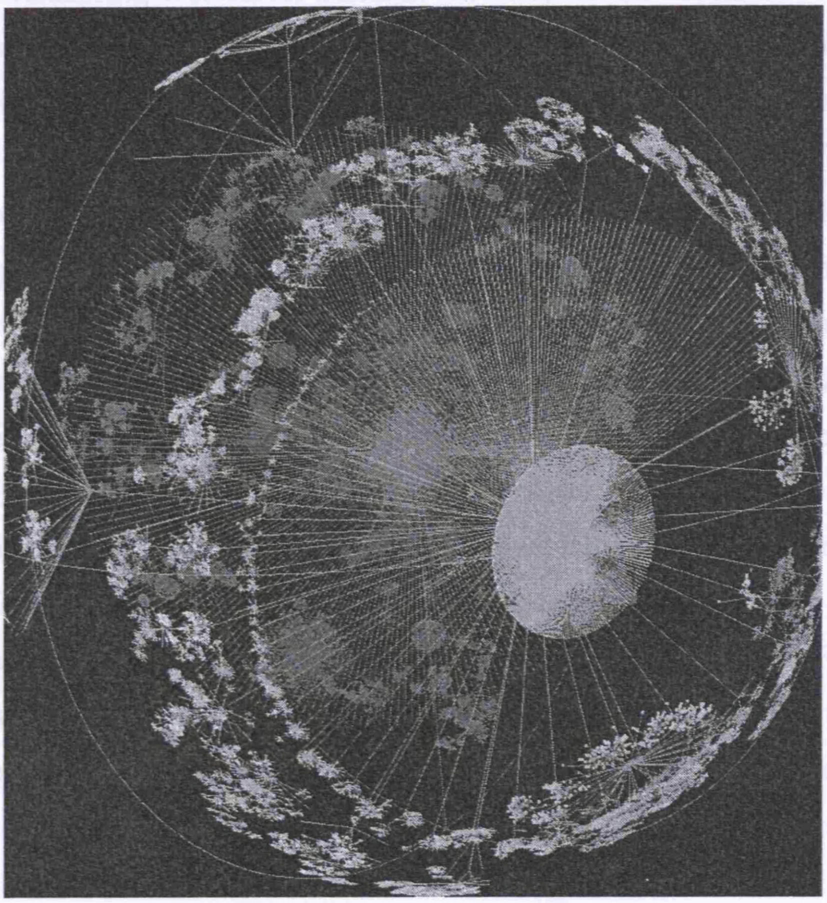

Figure 3.4: A screenshot of a three-dimensional hyperbolic visualisation of Internet topologies created by Young Hyun in 2000. It was produced using custom-written hyperbolic graph viewer called Walrus designed to allow researchers to interactively browse huge graphs (greater than 100,000 nodes). (Source: Courtesy of Young Hyun, Cooperative Association for Internet Data Analysis (CAIDA), <www.caida.org/~youngh/walrus/walrus.html >.)

In terms of map use, a good many 'maps of cyberspace' move beyond the static two-dimensional representational norms of mainstream cartography to provide interactive multi-dimensional visualisations. There are overlaps in this case with visualisation research being undertaken in the representation paradigm in cartography (discussed in chapter two). The lure of sophisticated three-dimensional graphics and virtual reality interfaces to produce mapping with the requisite 'cyber'-look has been a recurrent feature of this mode. The Earth globe aesthetic has proved to be a particularly popular backdrop onto which infrastructural data can be mapped (see the discussion in chapter four of the power visual metaphor for imagining the Internet). For example, Lamm *et al.*

(1996) visualising Web server traffic as 'skyscrapers' on VR Earth. (The striking images from this research proved to be suitably iconic that one was used as the major illustration of the 1999 *New York Times* story on cyberspace cartographies (see Figure 3.8 below). Eschewing the globe and restrictions of terrestrial referencing, others have produced immersive three-dimension visualisations of cyberspace operations in abstract space, such the Walrus system used to interactively display huge graphs of data routing in a hyperbolic space (Figure 3.4). In some respects these types of interactive three-dimensional visualisations of topological structures are the most innovative for cartographic practice by pushing outwards the boundaries of the map users experience. However, most also suffer with poor semiotic performance in actually conveying information for general audiences (Dodge and Kitchin 2000a). In terms of DiBiase's schema of the role of maps in the research process discussed in chapter two (see Figure 2.5), these kinds of interactive graph visualisations are designed primarily for use in private realm for 'visual thinking' rather than for public communication.

Many of the map-makers creating 'maps of cyberspace' would not class themselves as 'cartographers'. They are a diverse collection of individual explorers/programmers, academic research groups (typically from the computer science domain), market research companies, the marketing departments of networking / telecommunications corporations, and government statistical and regulatory agencies. Unsurprisingly, they tend to come from fields that are most involved in the daily production of cyberspace, having the need for maps to accomplish immediate pragmatic goals (e.g., engineers analysing network traffic and planning new infrastructure deployment, market researchers tracking and predicting the growth of the network, industry regulators monitoring competitiveness of provision for multiple services areas). Those directly responsible for building and operating the data networks underlying cyberspace are the most prolific single group of map-makers in this mode; however much of their work is for internal use and is never made public, except for specifically designed marketing maps (examined in chapter six).

In some senses then, many of these people are compelled to become cyberspace map-makers because the basic maps they needed to do their jobs do not exist within the normal cartographic supply-chain. There is no coverage of cyberspace in major world atlases, for example and the national mapping agencies, like USGS and Ordnance Survey, do not record telecommunications infrastructure in small scale topographic mapping; it is very much the poor cousin to other infrastructures, like railways, that are mapped in much greater depth[1]. A key reason for this is the 'invisibility' of much of the Internet's infrastructures, relative to other networks like rail or roads (see discussion in chapter four).

In terms of authorship, the 'maps of cyberspace' mode has offered a renewed scope for dedicated individual endeavour to make an impact. In much of conventional commercial and state-sponsored mapping, cartographic authorship has been firmly professionalised and largely anonymised. This is not the case with mapping the Internet, for example, because the network infrastructures open up new technical opportunities to be used to map themselves in really quite innovative ways and at very low costs (see Dodge and Kitchin 2006). This allows novel opportunities for what might called 'super-empowered individuals' to chart vast swathes of cyberspace with minimal resources, utilising recursive software algorithms to automate the surveying process and reduce the burden of charting huge volumes of data. The work of undergraduate physics student Stephen Coast[2] is a telling example. Individually he mapped the core topology of the Internet as a summer internship project in the Centre for Advanced Spatial Analysis in 2001 using software 'bots' to scan the network and report results to a database (in much the same way that search engines monitor the Web). Coast's work also highlights how whole territories of cyberspace can be remotely sensed from a single survey location.

Given the diversity of institutions and individuals producing 'maps of cyberspace' it is not surprising that they serve multiple normative purposes. At a basic level, most of the maps in the mode provide a visual census of where cyberspace nodes are located, and in very few cases the traffic that flows

[1] The Ordnance Survey's 'Digital National Framework' (marketed as their MasterMap product), for example, does not contain a coherent representation of telecommunications networks suitable for spatial analysis.

[2] Results of the project are available at <www.fractalus.com/steve/stuff/ipmap/>.

between them. (The 'where' in this case can be plotted in geographic space or according to some other topologic framework). 'Maps of cyberspace' at the level of infrastructure can detail how computers are physically wired together to create complex networks that operate over several spatial scales, from individual buildings up to global scale systems. Depending on scale, these maps can be used by engineers to install and maintain the physical hardware of the networks, by system operators to manage networks more effectively, and by marketing and business development departments to demonstrate the size and penetration of networked services (see chapter six for analysis of examples of the last instance).

Many of the 'maps of cyberspace' serve as significant components in the market-driven development of cyberspace fostered by global capital. They are produced as cartographic propaganda by companies and consultants who have vested financial interests in the expansion of cyberspace. Maps are deployed as persuasive devices (Tyner 1982) because they provide authoritative support to the rhetoric of universal expansion, helping to visually assert the global ambitions of corporations and as a means to exert sovereignty of private capital over public electronic spaces (Dodge and Kitchin 2000b). A examination of most ISP Web sites, undertaken in chapter six, reveals the presence of 'high-gloss' marketing maps showing a generalised and simplified view of the company's network. They usually represent the network on a familiar template of real-world geography. As such they have many design commonalties with airline route maps displayed in the back of in-flight magazines and are part of an established cartographic lineage of marketing maps used to highlight the advantages of the latest communications technology to prospective investors and potential customers (see chapter six for full discussion).

Beside selling cyberspace, another motive is census-mapping cyberspace in support of academic and policy analysis (see the analysis in chapter five for detailed empirical discussion). The results, with varying degrees of reliability and impartiality, are fed back into business strategies and government policy formulation, thereby directly effecting the future production of cyberspace. More recently, much of policy analysis work using census type mapping focused on explaining the exponential growth in Internet infrastructures, connectivity and usage. Visual summary presentation using statistical charts, diagrams and maps is common (Figure 3.5).

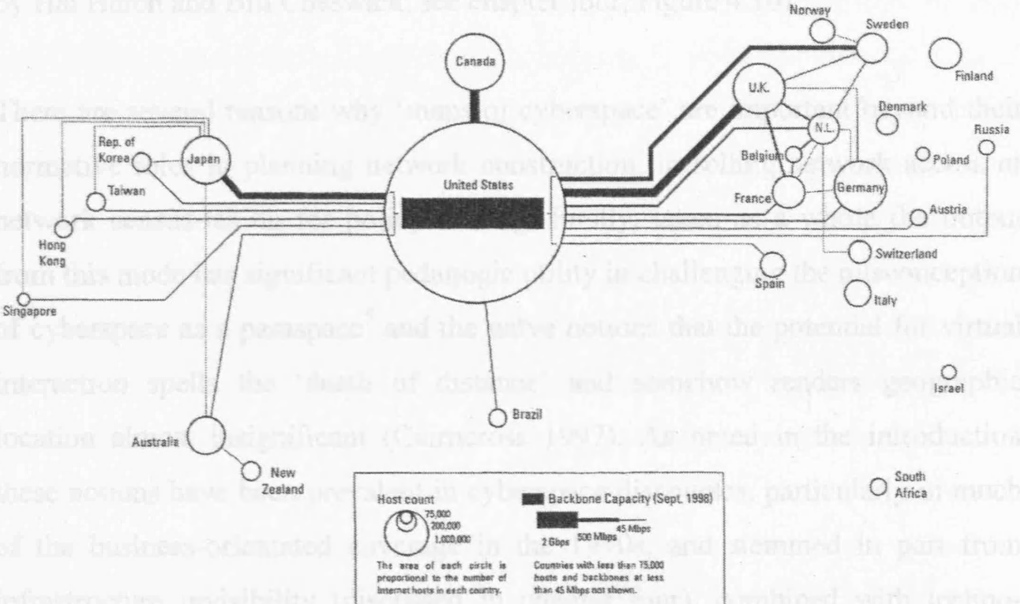

Figure 3.5: Diagrammatic summary of Internet bandwidth capacity between core countries in 1999. (Source: TeleGeography 1999, 34.)

TeleGeography, a market analysis firm based in Washington DC has produced some of the more innovative examples of cyberspace mapping for policy. They measure and map telecommunications traffic flows and Internet bandwidth between countries (Figure 3.5), and provide one of the most important and credible data sources for the growth of cyberspace. The company grew out of the pioneering work by telecommunications lawyer Gregory Staple in the late 1980s, who gathered telecom traffic flow data between countries for the first time (see Staple and Dixon 1992). Staple's goal was to map out the structures of telegeography; his motivation in doing this was simple: "At the time, I was a few streets away from one of London's best stocked book stores and I had the same frustrating experience; the information society was everywhere, but you couldn't find a map of who was connected to whom to save your job." (quoted in Dodge 2000e). While some of Staple's output used conventional statistical cartography templates (for example, see TeleGeography's wall posters[3]), he is also interested in more innovative visual vocabularies for 'maps of cyberspace' as evidenced by his publication of the 'The Whole Internet' maps[4] (based on the graph projection by Hal Burch and Bill Cheswick, see chapter four, Figure 4.10).

There are several reasons why 'maps of cyberspace' are important beyond their normative roles in planning network construction, in selling network access or network census-taking for policy-making. Firstly, taken as a whole the output from this mode has significant pedagogic utility in challenging the misconception of cyberspace as a paraspace[5] and the naïve notions that the potential for virtual interaction spells the 'death of distance' and somehow renders geographic location almost insignificant (Cairncross 1997). As noted in the introduction these notions have been prevalent in cyberspace discourses, particularly in much of the business-orientated coverage in the 1990s, and stemmed in part from infrastructure invisibility (discussed in chapter four), combined with techno-utopianist fantasies of transcendence of the physical constraints of embodied human lives and corporate dreams of borderless worlds.

The seemingly magical ability to surf effortlessly through online information, moving from website to website in a single click, belies the scale and sophistication of the socio-technical assemblage of protocols, hardware, capital and labour that makes this possible. Despite the virtualised rhetoric, this infrastructure assemblage remains embedded in real places and 'maps of cyberspace' have utility in revealing the intersections between virtual space and geographic space. Mapping is, therefore, significant as it can provide insights into who owns and controls the supporting infrastructure from where cyberspace is being produced. In addition, maps are especially useful for communicating this

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[3] See <www.telegeography.com/products/maps/cable/index.html>. The basis of the undersea cable map published in a Guardian news story was TeleGeography, see chapter four, Figure 4.1.

[4] Four iterations of this striking poster were sold by Staple's company Peacock Maps, <www.peacockmaps.com>. Note, I worked for Peacock Maps in 2001 and participated in the publication of the last version.

[5] Paraspace means 'other space' - a sublime space that has forms and practices alien to that in geographic space (see Bingham 1999).

kind of detail to public audiences because they use a familiar template of countries and continents.

Understanding the 'where' and 'how' of the physical embeddedness of data networks and information flows through mapping is also important because of the uneven geographical distribution of cyberspace and the consequent socio-spatial implications in terms of access and inequalities. The location and structure of infrastructure is a key determinant in access to cyberspace, affecting cost, speed, reliability, and ability to connect (Holderness 1998; Warf 2001). Maps in this cartographic mode can illustrate how, on a global scale, infrastructure is concentrated in certain countries (such as the USA, UK, Scandinavia), at the national scale how it is concentrated in certain regions (e.g., Silicon Valley, the west London-M4 corridor, the Helsinki metropolitan area), and even at very localised neighbourhood clusters within 'high-tech' cities like San Francisco or New York (see for example Zook's (2000; 2005) cogent economic analysis and mapping of Internet domain name ownership). Accessing cyberspace is fragmented along traditional spatial and social divisions with infrastructure density and variety being closely related to areas of wealth (see Warf 2001). These issues are discussed in depth in chapter five in relation to maps of Internet globalisation.

Despite much innovation and effort from the range of map-makers, in terms of coverage, the available 'maps of cyberspace' give only a partial view of the production of cyberspace. Mappable information is still limited in many areas; for example, the inability to measure information flows between and within cities. The early work by Gottmann and Board *et al.* analysing telephone call traffic discussed above has not been repeated for the Internet because of limited availability of representative datasets. And in some important respects, mappable information of cyberspace is actually diminishing. The growing diversity, size and privatisation of cyberspace are making it harder to survey and map legibly compared to say ten years ago. This has been acerbated with recent post-9/11 'chilling' (Zellmer 2004) in which details on cyberspace infrastructures and operating procedures are kept from public purview for 'security' reasons; for example, the Georgia Telecommunications Atlas (Figure 3.1 above) is no longer online. Visitors to the site looking to produce maps of network infrastructure are now informed: "Due to security concerns from telecommunications providers, the Georgia High-Speed Telecommunications Atlas is no longer available."[6]

Yet the 'maps of cyberspace' that have been created and published remain politically important, not because they accurately and reliably denote the shape of cyberspace itself, but because they reveal how certain people, groups and organisation perceive and (re)present cyberspace to themselves and to the outside world. All the 'maps of cyberspace' necessary have connotative meanings that expose the interests and agendas of the people who make them: for example, is cyberspace being presented as a dangerous, threatening place needing to be controlled? or as a new digital 'public square' for invigorating community and democracy? or a new market ripe for economic exploitation? The agendas in two particularly important classes of 'maps of cyberspace' are made apparent in chapters five and six through a semiotic reading of their connotative meanings.

3.2.3 The 'maps for cyberspace' mode

The extent and usage of cyberspace has grown very rapidly in the last decade. With so many distinct virtual spaces and users online, cyberspace has become an enormous and often confusing entity that can be difficult to cognise and navigate. The 'maps for cyberspace' mode focuses on helping people understand the structures of online spaces of information and social interaction, rendering them in visual form and enabling people to navigate through them. These are cyberspace cartographies designed purposefully as a means to explore 'inside the wires', rather than to see how the 'wires' themselves are produced.

It may seem surprising, in the first instance, that a worthwhile case can be made to use cartographic maps to navigate cyberspace. This surprise is based on two false assumptions: firstly, that cyberspace has no meaningful spatial structure and is somehow 'unmappable'; and secondly, that maps can only represent geographic phenomena in relation to the surface of the earth. Both these

[6] See <http://maps.gis.gatech.edu/telecomweb/index.html>.

assumptions are untenable for maps are not just geographic and cyberspace has meaningful structures to be surveyed (and calculated) and mapped, such as semantic similarity between content, affinity ties of differing strengths in online social networks, turn-taking in mediated conversations. The self-evident answer is that it *is* possible to make 'maps for cyberspace' - as many researchers have indeed done (cf. Dodge and Kitchin 2001, chapters three and four for myriad examples) - although as yet map-makers in this mode have largely failed to produce effective maps suitable for widespread public usage. In cognitive and semiotic terms there is no equivalent to the Tube map for the navigating the Web.

In terms of authorship, the range of work in this mode is undertaken by a surprisingly diverse group of map-makers, including graphic designers, sociologists, new media artists, information scientists, librarians and software interface engineers. Contributions by cartographers and geographers have been minimal (with the exception of the notable work by Skupin (2000) and Fabrikant, (2000)). The bulk of the work is being done within academic contexts, particularly in U.S research labs and universities. Also, quite a number of start-up companies have spun-out from academic research to develop novel interface concepts into commercial products[7], particularly so in the late 1990s dotcom boom when venture-capital was readily available. (Few survived the subsequent technology market crash and none has achieved large scale success in the commercial market.)

A number of computer science specialisms interested in the 'engineering' aspects of new interactive visualisation have also been heavily involved in the 'maps for cyberspace' mode, including researchers in computer graphics, human-computer interaction, visual analysis of massive datasets, and virtual reality areas. Many of these fields share common goals of being able to better understand information navigation and, thereby, create more efficient means of human-computer interactions. In some respects online spaces, such as the Web, provide a

[7] For example, Visual Insights, Perspecta, Inxight Software and Cartia were spins-off from cutting-edge research at Bell Labs-Lucent Technologies, MIT Media Lab, Xerox PARC, and Pacific Northwest National Laboratories respectively.

conveniently accessible, large-scale testbed for this work. In addition to these fields within computer science, an allied research community has grown up in the 1990s under the banner of information visualisation[8] which provides many of the most innovative 'maps for cyberspace' exemplars because of their specific emphasis on developing dynamic interfaces to navigate large volumes of textual data (see Card *et al.* 1999; Spence 2001).

Outside of computer science and technically-focused visualisation research, the information design community, with direct responsibly for the architecture of online content has been most active within the 'maps for cyberspace' mode; for example in terms of site maps on websites (e.g., Kahn 2000). Valuable but eclectic contributions have also come from new media artists, who are developing interactive maps as works of art (see reviews in Anders 1998; Holtzman 1997; Paul 2003) and as virtualised architectural spaces (e.g., Benedikt 1991; Spiller 1998). One especially interesting group here, working at the intersection between online art installations and software computation, are the new breed of so-called 'data-viz' artist/programmers including Ben Fry at the MIT Media Lab and Martin Wattenberg at IBM Research (see Dodge 2001c, 2001d).

3.2.3.1 The potential of information mapping

Cartographic concepts have utility for the maps for cyberspace mode since they can help render the intangible virtual media, composed of immaterial code (in essence just software algorithms manipulating database records) into visually tangible spaces[9]. Even though one cannot 'touch' hypertext, for example, it is possible to visually plot its structures on screen to aid navigation. Depending on their scale and design, maps of virtual media can give people a unique sense of spaces difficult to understand from navigation alone (Dodge 2000a). As such

[8] It has been defined by three of leading academic computer science researchers as follows: "The use of computer-supported, interactive, visual representations of abstract data to amplify cognition" (Card *et al.* 1999, 2).

[9] Of course, there are many other visual interface approaches beside cartographic mapping - the most common is the temporally ordered list of items, which underlies the experience of email for example.

notions from cartographic mapping applied to virtual media offers three distinct and interlinked advantages over other interfaces to cyberspace:

- Creating a sense of the whole information space,
- Supporting ad-hoc, interactive user exploration,
- Revealing hidden connections between data objects.

In a metaphorical sense information maps enable users to get 'above' the virtual space. In terms of the Web this kind of 'birds-eye view' function has been described by David D. Clark, Senior Research Scientist at MIT's Laboratory for Computer Science, as the missing 'up button' on the browser (Dodge 2000a). Such overview visualisation, displayed on a single screen for cognition at a glance, is particularly important when combined with support for interactive exploration given the nature of much of online information seeking is via unstructured and poorly formulated browsing and foraging techniques. "[A] user may be unable to say exactly what they are looking for in a collection of documents because they may not *know* exactly what they are looking for. They may want to discover *roughly* what is available in the collection and then, by exploration, gradually refine their inquiry" (Spence 2001, 179, original emphasis). Maps <u>for</u> cyberspace need to be able to show, in an intuitive and meaningful fashion, the structures of the information space in terms of direct relationships between documents (via citations or hyperlinks, for example), but also similarity in terms of shared themes, semantic connections and common patterns of usage. These structures and relationships are usually completely hidden in the presentation of conventional media interfaces, like the Web browser. Yet, this is often where users need insights to assist their visual-cognitive assimilation of the mosaic of available information. As cartographic theorist Bertin (1981, 64) reminds us: "Items of data do not supply the information necessary for decision-making. What must be seen are the relationships which emerge from consideration of the entire set of data. In decision-making, the useful information is drawn from the overall relationships of the entire set." The effective power of 'maps <u>for</u> cyberspace' comes from showing these relationships to users to enable them to make better decisions.

3.2.3.2 Spatialization for information mapping

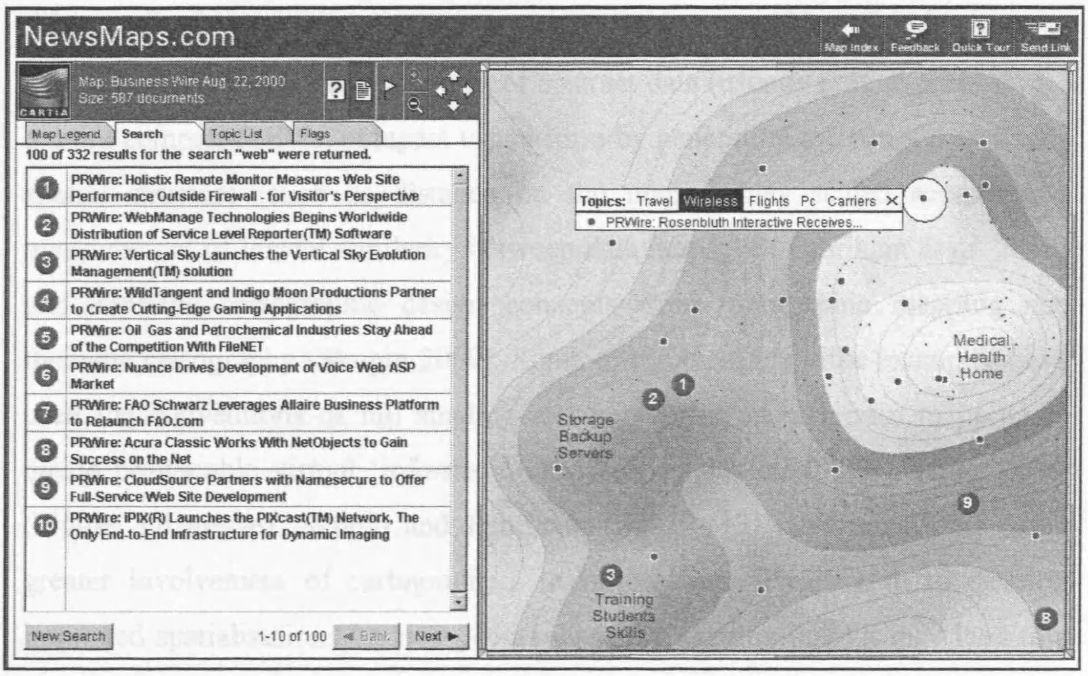


Figure 3.6: The NewsMaps interface was a navigable information terrain where the hills and valleys represented variable volumes of textual information. The white peak represents a large number of news stories discussing the same topic (labelled with keywords). The axes are a decorative device to frame the display and do not provide useful measurement. The interface was based on Cartia's Themescape spatialization system and was one of the more effective 'maps for cyberspace' produced in the late 1990s. (Source: author screenshot.)

Developments in the field of information visualisation in last decade have proved particularly fertile in creating novel visual metaphors for navigating high-dimensional information spaces through processes of spatialization (see Couclelis 1998; Fabrikant 2000; Fabrikant and Buttenfield 2001; Fabrikant and Montello 2008; Fabrikant *et al.* 2004). These are map-like interfaces that "rely on the use of spatial metaphors to represent data that are not necessarily spatial" (Fabrikant 2000, 67-68). According to Couclelis (1998, 209), "true spatialization goes beyond the conversion of information into general visual patterns to reproduce aspects of the kinds of spaces that are familiar to people from everyday experience ... Spatializations work by allowing the establishment of metaphors linking a particular task domain with a familiar domain of experience in such a way that the modes of thought and action appropriate in the familiar domain area also appropriate in the task domain."

Spatialization renders large amounts of abstract data (usually textual corpus) into a more comprehensible, compact visual form by generating meaningful synthetic spatial structure (such as distance on the map display scaled according a measurement of lexical similarity between data items; see Fabrikant *et al.* 2004) and applying cartographic design concepts from topographic mapping and thematic cartography (Skupin 2000). Some of the most map-like examples have used the conventions of hill shading and contouring from terrain mapping to create browseable virtual 'information landscapes' (Wise 1999; Dodge 2000f) (Figure 3.6 above). Skupin and Fabrikant (2003, 113) have called for much greater involvement of cartographers in information visualisation to develop improved spatializations for non-geographic data, arguing that "it may lead to a renewed interest among non-cartographers in how our community has managed to not only represent the infinitely complex geographic reality within a limited display space, but also do it in a manner that enables people to recognize their world within it."

3.2.3.3 Challenges in information mapping

Given these potential advantages, actually creating practicable spatializations, however, faces real challenges. This is particularly the case, firstly, because cyberspace is new and diverse. It is not a single, homogenous and continuous phenomenon, but a myriad of rapidly evolving digital databases, channels, and media, each providing a distinct form of virtual interaction and communication (as shown in Figure 1.1 in the introductory chapter). Secondly, many virtual spaces are overlapping and interconnected, but often in ad-hoc and unplanned ways, giving rise to complex rhizomatic[10] structures that can not easily be surveyed and mapped. Cyberspace, composed of infinitely malleable software code that can produce numerous media forms - including Web pages and their hyperlinks, social interactions as text in synchronous chat rooms and

[10] A rhizome is a tangled root system that develops horizontally, and in a non-hierarchical fashion. Hypertexts are said to be rhizomatic in form because any node may connect with any other.

asynchronous mailing lists, three-dimensional VR environments, huge distributed file corpuses on peer-2-peer networks - all with "their own sense of place and space, their own geography" (Batty 1997, 339).

Some virtual spaces can be highly mutable and in continual informational flux as content is refined, expanded and deleted in unpredictable ways - the average life span of a Web page in 2000 was reported to be only 44 days (Lyman 2002). These are inherently transient landscapes, but where changes are 'hidden' until they are encountered. Change can happen instantaneously, for example deleting a Web page leaves behind no trace (unless archived elsewhere previously). The lack of reciprocity in relations means an information node can vanish without notice or notification to any other party (hence the problem of 'dead-end' hyperlinks on the Web). The programmed logic of cyberspace – presence or absence, zero or one – makes for a hard landscape to map.

Furthermore, these issues of information mutability and transience are likely to grow, and become obfuscated by increasing use of encryption and ad-hoc distributed architectures (e.g., P2P and WI-FI mesh networks) making mapping even harder[11]. The task of generating even a basic index of parts of cyberspace for example, continues to tax the largest corporations and government agencies. The Web search engines, for example, have failed to keep pace with the growth and mutability of just this one part of cyberspace. Of course, issues of data currency and change management are well known in cartography (e.g., the uneven revisions cycles of paper topographic maps by some organisations). However, the surveyed environment represented on conventional topographic maps is really quite a stable place (change tends to be gradual in relation to human perceptions; most things stay the same, and when they do change, they typically leave evidence behind in the material landscape.) The physical fixity, friction and inertia of geographic space means the 'shelf-life' of most maps is

[11] Tim Berners-Lee and others counter that the growth and complexity of online information resources can be more effectively managed with application of XML to encode semantic meanings and the use of collaborative user tagging and rating. Additionally, the wholesale automatic geocoding of information objects, as they are created and transmitted, opens up interesting possibilities for spatial indexing, filtering by distance and searching by geographic location.

quite long (most of the information printed on a Ordnance Survey Landranger map remains valid for decades). There is no such friction or inertia in cyberspace and the 'shelf-life' for many cyberspace maps is terribly short. What is really needed are 'maps for cyberspace' that are capable of dynamically mapping out virtual space in real-time, much like a radar map for tracking weather patterns.

A third set of challenges in mapping relate to the nature of the space. Cyberspace offers media that at first, often seem contiguous with geographic space, yet on further inspection it becomes clear that the space-time laws of physics have little meaning online. This is because virtual spaces are purely relational. They are not 'natural', but are solely the productions of their designers and, in many cases, users. They adopt the formal qualities of geographic (Euclidean) space only if explicitly programmed to do so, and indeed many media such as email have severely limited spatial qualities. Significantly, many virtual spaces violate two principal assumptions of modern (Western) cartography making them difficult to map legibly using conventional techniques[12]. The first of these are the Cartesian properties of space as continuous, ordered and reciprocal; there are no sudden gaps or holes in the landscape, everything is somewhere, and the Euclidean notion of distance holds true, i.e. the distance from *A* to *B* will be the same as from *B* to *A* (Staple 1995). Yet parts of cyberspace are discontinuous, lacking linear organisation and in some cases elements can have multiple locations.

The second assumption is that the map is not the territory but a representation of it, (i.e. the territory has a separate, ongoing existence and meaning beyond the map.) Yet there are examples of virtual space where in a literal and functional sense the map *is* the territory. Cartesian logic collapses and there is no reality independent of the representation (Dodge and Kitchin 2000a). This conflation of the map and the territory is most obviously seen in hypertext spaces when the structuring of the data is both the space and its map. This can be experienced in the experimental three-dimensional 'fly-through' spatializations of hypertext, such MIT Media Lab's Perspecta system (Holtzman 1997) or Apple's HotSauce

[12] Of course, a number of geographers have undertaken work on non-Euclidean geographies using relational measurements of distance (e.g., Gould 1991).

navigation map-interface (Figure 3.7) (cf. Dodge 2001a). Staple (1995, 71) comments further that in "a very real sense the session is the map. Or paraphrase Marshall McLuhan, the medium is the map." Interestingly, none of the experiments in 'fly-thru' map-spaces that emerged in the 1990s gained widespread usage despite great hope by some pundits that they would overturn the page-by-page view of the Web (a visual paradigm based largely on book metaphors) ingrained in browsing software.

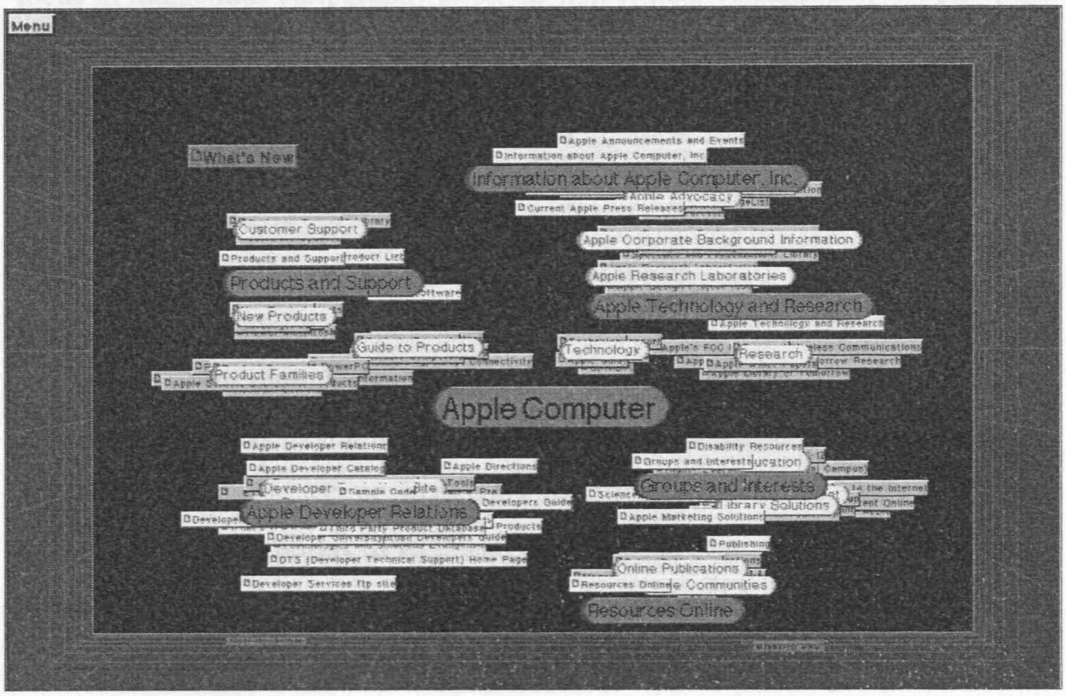


Figure 3.7: A screenshot of the HotSauce fly-through interface to Web space produced in the mid 1990s by Ramanathan V. Guha while working at Apple Research. It was an experimental three-dimensional abstract representations and illustrates the degree to which 'maps <u>for</u> cyberspace' mode stretches beyond cartographic conventions. As an effective navigation map it was a failure. (Source: author screenshot.)

At present, it is probably fair to say that in relation to the challenges of producing effective 'maps <u>for</u> cyberspace', the current map-makers are at a comparable stage of development to the cartographers at start of Renaissance period in creating comprehensive and useful maps. Although armed with a knowledge of traditional mapping and sophisticated computing, mapmakers are lacking the vital 'blueprints' that Ptolemy provided for European cartographers in terms of a projective grid for plotting the knowledge of vastly expanded territories that the New World explorations brought back. At present there is no equivalent world-making grid of latitude and longitude for cyberspace. As a consequence, many cyberspace cartographers have generally resorted to extending existing methods.

One productive route forward for this mode is to draw upon the mapping epistemologies of non-western, aboriginal cartographies, which are markedly different from the dominant conventions and norms of Western cartography, and might well provide insights for future cyberspace mapping projects. Much of the focus in indigenous cartography is on the non-textual visualisation of conceptual links, pathways and relationships between space rather than the geometric grids and locational accuracy emphasised in modern (Western) cartography.

3.3 Literature on the cartographies of cyberspace

There is a substantial body of critical analysis on the history of cartography, and on contemporary digital mapping and the practices of GIS, yet there has been little scholarly work examining cyberspace cartographies *per se*. While examples of cyberspace maps crop up frequently in different literatures, such as network maps used as illustrations in technical guide books (e.g., Quarterman 1990) and histories of the Internet (e.g., Abbate 1999; Hafner and Lyon 1996; Salus 1995), most are without systematic comment on their semiotic properties or their wider social significance.

To begin the summary of relevant literature on cyberspace cartographies, I want to consider Gregory Staple's paper, *Notes on Mapping the Net: From Tribal Space to Corporate Space* (1995). (Staple is a telecoms lawyer and the founder of TeleGeography, as noted above.) Although it is a non-academic treatise in some respects, and was published in grey literature, the paper provides a valuable perspective on the emergence of cyberspace cartographies from one of the pioneers in the field. Staple argues firstly that cyberspace is significant in extending the centuries old debate about 'what are maps' and starts by drawing direct parallels to the explorative drive from the 'age of discovery' to define contemporary cartographic motivations. He notes that effective maps of cyberspace are rare because "[f]ew among this frontier fraternity" of hackers and webmasters, "have both the navigational and drafting skills of a Ferdinand

Magellan or a James Cook" (Staple 1995, 66). He then provides a role call of 'issues' that make cyberspace mapping challenging, including the lack of an established mental conception of what cyberspace *should* look like: "Ask a communications engineer to draw a picture of cyberspace and you are likely to get a sea of clouds each representing a different network" (Staple 1995, 67) (see also chapter four). The confusion in how to represent cyberspace calls for a clear separation of the "hardware and software side of the on-line world." (Staple 1995, 67), matching partially the mode conceptualisation used here in this thesis (i.e., 'maps <u>of</u> cyberspace' and 'maps <u>for</u> cyberspace').

Staple's principal interest is in 'cybermaps' to represent information spaces for user navigation (what I define as the 'maps <u>for</u> cyberspace' mode). To achieve this, he notes, new maps will likely be cartographically unconventional (i.e. breaking the Euclidean conventions of most Western maps) and he draws on ideas from tribal mapping as a source for such alternative conceptions. Importantly, connectivity rather than continuity of virtual spaces of cyberspace need to be represented to users and he cites American Indian and Australian Aboriginal mapping as a useful model for this: "Cybermaps like tribal maps may ... dispense with conventional perspective to conserve connectivity. They are true to the land, not to the theodolite" (Staple 1995, 68). Staple means the focus of measurement and mapping should be on overall topology rather than topographic detail. He concludes the paper by discussing the social implications of cybermaps in relation to the changing forms of cyberspace evident in the mid 1990s with the start of rampant commercialisation, arguing that initial exploration mapping will open up cyberspace to the controlling cartography of "a more mercantile genre" with universalising grids capable of locating all virtual territory. "Tomorrow's cybersmaps" he concludes "will record the boundaries of corporate space on the Net even as earlier ones illustrated its tribal origins" (Staple 1995, 72).

In terms of writing by academic cartographers, there are two descriptive papers by Jiang and Ormeling (1997 and 2000) which do engage with cyberspace cartography directly, although they do not attempt any theoretically-informed critique of their social implications. The lead author is heavily involved in visualisation research and the papers were both published in the *Cartographic*

Journal, the house journal of the British Cartographic Society which speaks to 'mainstream' practitioners and researchers. Both papers review a range examples of 'cybermaps' with an explicit 'call to arms' to cartographers to lend their skills and experience to make improved maps, asserting that: "cartographers with a long standing tradition of mapping geographical space, can make an important contribution to mapping cyberspace" (Jiang and Ormeling 1997, 111).

Jiang and Ormeling's first paper, *Cybermap: The Map for Cyberspace* (1997), defines the nature of the 'cybermap' elliptically as a "special map for cyberspace" (p.112) that encompasses representations of both the physical network and the information spaces. Drawing on theories of maps as communication tools, they set out a three-fold 'functional classification of cybermaps': navigation maps, maps for cyberspatial analysis, maps for persuasion. The short paper includes five colour cybermaps as illustrations, but these are not politically critiqued. The authors use them in the affirmation of the need for professional cartography, somewhat snobbishly noting that "[a]s many cybermaps are produced by non-cartographic professionals, it is unavoidable that some low quality maps are created."

Jiang and Ormeling's second paper, *Mapping Cyberspace: Visualizing, Analysing and Exploring Virtual Worlds* (2000), covers similar ground to the first, with the map again normatively defined as "a visualisation tool for understanding and perception of space" (p. 118). They set out a somewhat modified conceptualisation of cyberspace mapping as being concerned, firstly, with analysing the geography of the "physical anchorages" of Internet following the "principle of traditional thematic mapping" (Jiang and Ormeling 2000, 118), secondly, a typology of network forms in which the Internet is visualised as non-geographic trees and graphs (they cite the Cheswick-Burch visualisation as an exemplar; see Figure 4.10). Lastly, they argue cybermaps are the means to produce "general purpose maps for virtual worlds" (Jiang and Ormeling, 2000, 118) as an aid to user navigation through three-dimensional space.

Batty and Miller (2000) bring the concept from quantitative modelling of accessibility into their analysis of representations of different types information space. They are concerned with developing a research agenda for understanding the nexus between material and virtual spaces, the hybrid space that they argue will be the "focus for a new geography of the information age" (Batty and Miller 2000, 134). Attempts to directly map out virtual spaces using traditional techniques developed for Euclidean landscapes, they argue, may well not be applicable because of the ease with which 'rules' of geographic space are broken and the unsuitability of the existing tools: "current GIS software does not treat non-Euclidean space in an appropriate way" (Batty and Miller 2000, 136) they point out. An alternative, to map the real-world locations of the physical and logical components of virtual space, is again viewed with caution by Batty and Miller because "[t]he spatial/geographical metaphor may not be appropriate, particularly since information flow in most networks apparently does not correlate with geographical space" (Batty and Miller 2000, 136). This is an issue because fluid and uncertain phenomena are hard to represent in cartographic meaningful ways.

One route forward, they suggest, might be to look beyond mapping the 'surface' morphology of cyberspaces towards an analysis of the structural process underlying cyberspatial production by modelling interactions using measures of latency instead of Euclidean distance to "see whether or not the frictionless world that has emerged has any parallel in traditional geographic spaces" (Batty and Miller 2000, 139) or by applying the notion of power laws and small world networks to understand the emergent properties of information objects (such as Web sites and their hyperlink structures). By way of conclusion they set out a fourfold research program for representing hybrid space (p. 144) focused on (1) visualisation of connections between material and virtual geographies by augmenting existing measures of accessibility and developing new ones; (2) researching information flows and costs in relation to existing market, social and institutional processes; (3) mapping activity spaces by extending time geography theories to take account of network flows; (4) developing tools for cyber-navigation. This agenda has clear overlaps to my conception of cyberspace cartography, with the first two items aimed at advancing the 'maps <u>of</u> cyberspace' mode and the other two items come within the remit of the 'maps <u>for</u> cyberspace' mode.

Castells' (1996) sophisticated sociological theorisation of the network society was founded on the power of informational flows to reconfigure time-spaces of material places. In his book, *The Internet Galaxy*[13] (2001) he analyses in more depth the material production of the Internet with a review of the geography of the infrastructure with descriptive statistics and census-type mapping. He sets out a three-fold schema for analysis that in many respects correlates to major types of 'maps of cyberspace' mode outline above. The first element in the schema is the "technical geography" by which Castells' (2001, 208) refers to "the telecommunications infrastructure of the Internet, the connections between computers that organize Internet traffic and the distribution of ... bandwidth". The second element is the customer statistics, especially concerning the uneven geographic distribution of access and usage. The final element in Castells' schema is the economic geography of Internet production, which has a much more spatially concentrated pattern that usage. Drawing heavily on the work of economic geographer Zook, the chapter includes seven illustrative thematic maps of Internet statistics that show very much the conventional face (and normative utility) of cyberspace cartographies to make intangible spaces seem tangible to a non-technical audience.

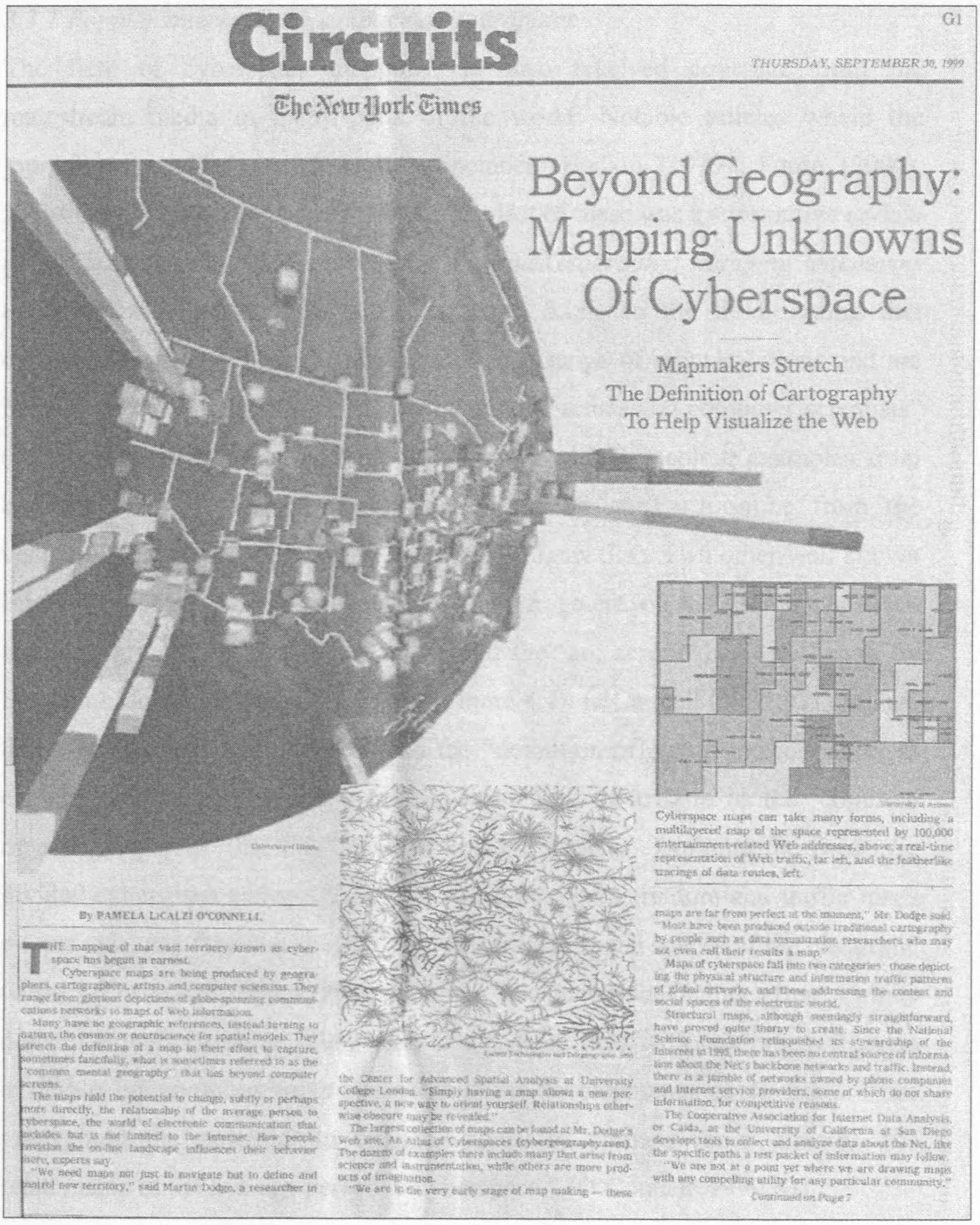
Outside of academic geography, the most theoretically sophisticated work on cyberspace cartographies is the paper by Harpold, titled *Dark Continents: Critique of Internet Metageographies* (1999). Coming from the cultural studies domain, Harpold provides a cogent postmodernist critique of maps of global-scale Internet infrastructure, richly illustrated with relevant empirical evidence. He views much of the output of the 'maps of cyberspace' modes as a pernicious new 'metageography'[14] sustaining the information society. "[T]he inherent selectivity and social subjectivity makes a map", Harpold (1999, 18) argues, "a

[13] As an interesting side point, the book's cover features a version of the Burch-Cheswick Internet graph as its central motif. Clearly this image conjured up, both, the space of networks as well outer (galactic) space in the mind of the designer (see discussion in chapter four).

[14] Harpold's concept of metageography, following Lewis and Wigen (1997), is defined as "sign systems that organize geographical knowledge into visual schemes that seem straightforward, but which depend on historically- and politically-inflected misrepresentation of underlying material conditions." (p. 5).

problematic construct for describing the heterogeneous conditions and practices of the emerging global telecommunications networks." He is particularly concerned with the politics of silence and the iniquitous *under* representation of the peripheries of cyberspace as evidenced in the blank spaces of the African continent on most infrastructure maps. He draws direct ideological parallels here to the colonial mappings of the nineteenth century, arguing "[t]he blank region is 'empty' only in relation to the comparable fullness of the rest of the map" (Harpold 1999, 3). He proceeds to trace out the implications of using nation-state boundaries as the 'natural' background to represent Internet diffusion, bandwidth and access, when the motive forces behind the processes are operating in a multi-scalar networked political economy. The result, he agues, is that these kinds of 'maps <u>of</u> cyberspace' are deeply deceptive, overstating the extent of Internet diffusion because fundamentally they are unable to "account for the extreme local obstacles which must be overcome before anything like a viable African Internet is possible, at least as netizens of digitally-saturated, liberal-democratic nations understand the Internet." (Harpold 1999, 12)

In Harpold's opinion (1999, 17), too many 'maps <u>of</u> cyberspace', by opting for conventional geographic projections, nation state boundaries and signs systems of thematic cartography, produce mythologies that reduce the Internet into categories of "on/off, traffic/no traffic, wired/unwired". Thus the maps work, Harpold asserts, as a display of "counterfeit ubiquity and technological reasonableness" that masks the unevenness of the process of Internet diffusion and the extent to which the network will further acerbate social difference between places. He ends his analysis with a call to map the Internet using a different cartographic imagination, with "new schemes for representing the archipelagic landscapes of the emerging political and technological world order." (Harpold 1999, 18). It is not clear whether these have been drawn yet or, indeed, whether they can be drawn at all by map-makers cultured with conventional Western metageography.



Circuits

G1

THURSDAY, SEPTEMBER 30, 1999

The New York Times

Beyond Geography: Mapping Unknowns Of Cyberspace

Mapmakers Stretch
The Definition of Cartography
To Help Visualize the Web

Cyberspace maps can take many forms, including a multilayered map of the space represented by 100,000 entertainment-related Web addresses, above; a real-time representation of Web traffic, far left, and the featherlike tracings of data routes, left.

By PAMELA LiCALZI O'CONNELL

THE mapping of that vast territory known as cyberspace has begun in earnest.

Cyberspace maps are being produced by geographers, cartographers, artists and computer scientists. They range from glorious depictions of globe-spanning communications networks to maps of Web information.

Many have no geographic references, instead turning to nature, the cosmos or neuroscience for spatial models. They stretch the definition of a map in their effort to capture, sometimes fancifully, what is sometimes referred to as the "common mental geography" that lies beyond computer screens.

The maps hold the potential to change, subtly or perhaps more directly, the relationship of the average person to cyberspace, the world of electronic communication that includes but is not limited to the Internet. How people envision the on-line landscape influences their behavior there, experts say.

"We need maps not just to navigate but to define and control new territory," said Martin Dodge, a researcher in the Center for Advanced Spatial Analysis at University College London. "Simply having a map allows a new perspective, a new way to orient yourself. Relationships otherwise obscure may be revealed."

The largest collection of maps can be found at Mr. Dodge's Web site, An Atlas of Cyberspaces (cybergeography.com). The dozens of examples there include many that arise from science and instrumentation, while others are more products of imagination.

"We are in the very early stage of map making — these maps are far from perfect at the moment," Mr. Dodge said. "Most have been produced outside traditional cartography by people such as data visualization researchers who may not even call their results a map."

Maps of cyberspace fall into two categories: those depicting the physical structure and information traffic patterns of global networks, and those addressing the content and social spaces of the electronic world.

Structural maps, although seemingly straightforward, have proved quite thorny to create. Since the National Science Foundation relinquished its stewardship of the Internet in 1995, there has been no central source of information about the Net's backbone networks and traffic. Instead, there is a jumble of networks owned by phone companies and Internet service providers, some of which do not share information, for competitive reasons.

The Cooperative Association for Internet Data Analysis, or Caida, at the University of California at San Diego develops tools to collect and analyze data about the Net, like the specific paths a test packet of information may follow.

"We are not at a point yet where we are drawing maps with any compelling utility for any particular community."

Continued on Page 7

Figure 3.8: The highly illustrated first page of a major story in the *New York Times* that publicized the notion of cyberspace cartographies at the end of the 1990s. (Source: O'Connell 1999, G1.)

3.3.1 Popular interest in cyberspace cartographies

The field of cyberspace mapping has also received coverage from the mainstream media in many parts of the world. Notable articles where the journalists provided useful analysis includes: Bodzin (1999), Forde (2000), Johnson (1999) and O'Connell (1999). The last of these was a substantive review article in the *New York Times* entitled *Beyond Geography: Mapping Unknowns of Cyberspace,* which provided a coherent frame to the field, noting that cyberspace cartographies encompass a diverse range of representations and are being "produced by geographers, cartographers, artists and computer scientists" (p. G1). The story was illustrated prominently with five colour examples from both modes with the front page dominated by an Earth globe from the visualisation research of Lamm *et al.* (1995) (Figure 3.8). Two other well known Internet visualisations were used, firstly a fragment of the Burch-Cheswick topology graph (see also Figure 4.10) and the 'arc across the world' map by Stephen Eick and colleagues (see also Figure 4.4). O'Connell (1999, G1) argued that cyberspace cartographies stretch the "definition of a map in their effort to capture, sometimes fancifully, what is sometimes referred to as the 'common mental geography' that lies beyond computer screens." Defining the field, she divided cyberspace cartographies into two types, infrastructure and traffic maps on one side, and "those addressing the content and social spaces of the electronic world." (O'Connell 1999, G1) on the other. The quotes she includes from various domain experts create an impression of a nascent field with few practical maps available, but an upbeat prognosis about future developments; as she notes: "The maps hold the potential to change, subtly or perhaps more directly, the relationship of the average person to cyberspace." (O'Connell 1999, G1).

Chapter Four

Imagining Internet Infrastructures: Spatial Metaphors and Scientific Inscription

4.1 Introduction: explaining what the Internet looks like[1]

There are several kinds of spatial imaginings that have been exploited to establish the Internet as something 'real' and to prove the 'matter of fact' existence of its infrastructure to different audiences by explaining 'what the Internet looks like'. These are significant in how they work to overcome the problems of the invisibility and intangibility of the Internet as an infrastructure. How do you explain the Internet when you cannot see and touch it?

[1] (Source of cartoon: Robert Thompson, *The Guardian*, Online section, 29 March 2001, page 4.)

Imaginings of infrastructures were particularly prevalent in the first half of the 1990s, when the Internet emerged rapidly as a new social-technical phenomenon in advanced capitalist countries and needed to be 'explained' in accessible ways to the majority of people who had not experienced it for themselves. This was especially because the Internet as a entity has no singular, manifest representation. Unlike transportation and telecommunications there is no one material device that unambiguously signifies the Internet. Further complicating the matter, the Internet is often typified as a place rather than an object or media (as illustrated by the cartoon above). Early in the Internets' entry into the public consciousness, it had an imaginal malleability as people had no fixed conception of what it was, how it worked, whether it was valuable to them, or whether they could trust it. As a result the influence of particular spatial metaphors, geographical representations and scientific inscriptions in shaping perceptions was strong.

In this chapter, I consider how different types of spatial imaginary of the Internet have been deployed to overcome infrastructural invisibility and work to forge the disparate and fragmented networks into a unitary entity that could be trusted. This imaginary is examined in two broad categories. Firstly, for general audiences, the range of verbal and visual metaphors that were deployed is considered. While such metaphors can be dismissed as mundane, Vujakovic (1998, 158, added emphasis) points to their social power, noting the "common acceptance of a *particular* metaphors (propagated or reinforced by the media) may lead to a limited view of an issue and the closure of constructive alternatives."; and I think this is apposite to particular kinds of spatial metaphor than have been applied to the Internet. Secondly, for the research-engineering audiences, I examine the role of scientific inscriptions in constructing facts about the Internet's structure and operations. To begin, I unpack the nature of the Internet's invisibility.

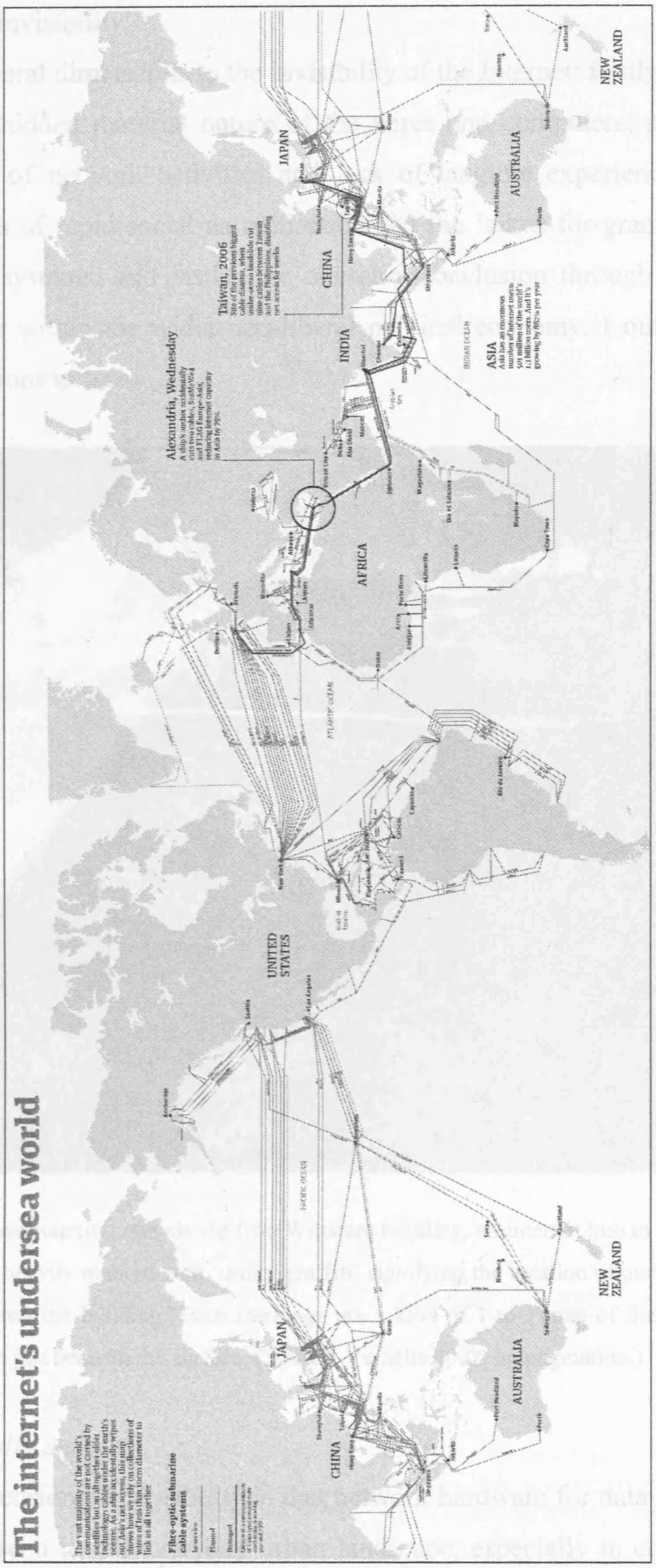


Figure 4.1: Cartography denotation necessary to make invisible Internet infrastructure visible for readers of a newspaper story about cable cuts and their impact on the Internet. (Source: *The Guardian* 2008, 22-23.)

4.2 Internet 'invisibility'

There are several dimensions to the invisibility of the Internet: firstly, the unseen, ignored and hidden material nature of the wires and computers; secondly, the transparency of network activities and lack of tangible experience for users; thirdly, issues of rapid social naturalisation and the 'taken-for-granted' banality of technical systems; and lastly, the conscious occlusion through institutional normalisation within the wider neo-liberal political economy. I outline each of these dimensions in turn.

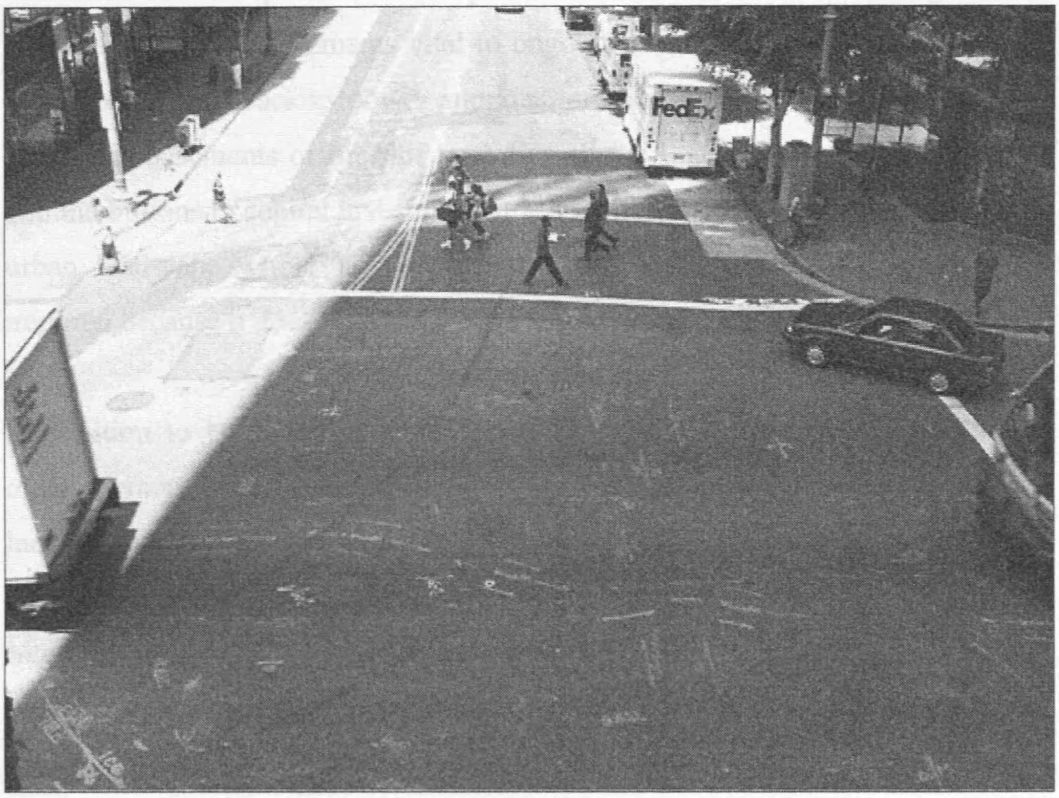


Figure 4.2: A road junction outside the One Wiltshire building, an internet hub in downtown Los Angeles, that is heavily marked with 'utility graffiti' signifying the location of underground cable routes leading into the building. Such markings are a kind of 1-to-1 map of the complexity of what lies unseen just beneath the surface. (Source: Varnelis 2002, no pagination.)

4.2.1 Materially unseen

The first dimension of invisibility is that network hardware for data transmission is largely unseen in the everyday urban landscape, especially in comparison to the physical presence of other communications systems (roads, railways, airports, postal mail and the like). The Internet as infrastructure is very briefly visible as fibre-optic cables are rolled out in the streets, but is quickly subsumed beneath roads and pavements. The 'wires' of the Internet through cities and across countries are almost universally routed subterraneously (Figure 4.2), and between continents lie along the ocean floors (Figure 4.1). The Internet is also dematerialising further as the actual wires are rapidly being replaced by wireless transmission that invisibly carries data unfelt through buildings and bodies.

The infrastructure at the ends of the wires, the network switches and computer servers, have a small physical footprint, and are usually hidden away in unmarked service spaces and anonymous secure, windowless buildings. Other supporting hardware elements vital to ongoing Internet production, such as air-conditioning and backup power supplies, are separated from people by being located in basements or on roof tops. For all the hype surrounding the Internet and the billions in capital investment, it has remarkably little visual impact on the urban landscape. Other tangible or noxious externalities of the Internet are minimal because it does not produce noise or other noxious pollution[2].

In addition to being out-of-sight and relegated to non-human serving spaces, other elements of the network hardware that are manifestly visible in the landscape are effectively made invisible because they are mundane ('invisibility by being ignored') or because they are not associated with the operation of the Internet ('invisibility by misconception'). For example, the wiring cabinets[3] aggregating customer telephone lines, which are now vital to broadband Internet distribution, are a common sight on pavements but are an anonymous and unmarked part of street furniture.

The material invisibility of the Internet is being actively encouraged in some quarters as part of more recent cybersecurity initiatives in which critical and

[2] Moreover, the negative externalities of manufacturing I.T. hardware are concentrated and largely remote from the affluent places of Internet consumption as a consequence of global supply chains. The disposal of computing equipment is also highly polluting, but again is hidden from the view of most people (see BAN 2002).

[3] In the UK, British Telecom has some 90,000 such 'primary cross-connection point' cabinets. They are usually painted an unassuming green colour, see <www.btplc.com/Thegroup/Networkstory>.

vulnerable elements of the infrastructure are thought to be best protected by being kept anonymous and secret (Gorman 2004). Such 'security through obscurity', leaving important places deliberately undocumented, has a long tradition, including in the production 'rules' of state cartography (Board 1991).

It is not only the ongoing hardware production of the Internet that is unseen; at the infrastructural level what is carried by data networks is entirely invisible in a phenomenological sense. Unlike cars on the road, trains on the track, or letters in the mail, the packets of data flowing through the Internet do not exist at the analogue scales of human senses. Bits (binary digits) of data are composed of discrete states of energy propagated at various wavelengths (light, radio, microwave, and so on) and have "no colour, size, or weight, and can travel at the speed of light ... [they are] a state of being, on or off, true or false" (Negroponte 1995, 14). While the bits are easily interpreted by software, they must be rendered through interfaces for people to comprehend. It is, therefore, not possible to observe the operation of the Internet unmediated. This is problematic, in particular, for companies selling Internet network services who need to make their infrastructure into something potential customers can trust. As a consequence they have to construct a connotation of infrastructure in a way people expect it to look using a range of visual metaphors, of which world maps showing the geography of routes is a primary vehicle (see case study analysis in chapter six).

4.2.2 Transparent in use

At a higher level than traffic flows, the Internet is also 'invisible-in-use' because data networks are intangible in terms of consumer experience. In conventional transportation infrastructures, passengers and drivers have innate and phenomenological knowledge of the networks through the journey experience. They comprehend the physical nature of the infrastructure by kinaesthetic interaction with cars, trains and planes - the direct 'seat of the pants' feel of the network. Telecommunications, in their inherent virtuality, are completely lacking such experiential comprehension. The *lack* of human touch defines *tele*-communications.

No knowledge of the Internet as infrastructure is gained from browsing the Web for example, it gives off no physical sensations. The majority of people on the Internet are never aware of the vast infrastructure they are utilising because it is consciously hidden from them, behind software interfaces. (Again, as noted above this is problematic for companies in the actual business of Internet infrastructure, who commonly use deploy market maps to give potential customers a visible sense of how extensive and powerful their network is; see discussion in chapter six.) Such infrastructural concealment is seen as a good thing by the industry - it is described as the 'network being transparent to the user'[4]. A key part of the power of the Internet has been its ability to provide seamless, end-to-end, communications services so that users do not have to worry about the structure of the underlying networks and the complex ways in which traffic is transmitted. Indeed, one might argue that the Internet could only become such a successful and widely used media of communication once its arcane technicalities were rendered sufficiently invisible to users, through developments such as the Web browser.

Moreover, a large cadre of computer science researchers, network engineers and industrial designers are striving to greatly increase the degree to which computers and the Internet fade into the fabric of everyday activities. Working under the banner of pervasive computing they are striving for systems that are "so imbedded, so fitting, so natural, that we use it without even thinking it" (Weiser 1991, 94). Scholars in this area argue that current ICT use, is in fact, not transparent enough, requiring too much cognitive effort to achieve the desired results (cf. Norman 1998). The promise of nomadic, always-on access through wireless networks will, advocates argue, make the Internet as invisible and ubiquitous as air.

4.2.3 Disappearance by social naturalisation

> The conduct of daily life surely demands a tactical lack of curiosity! But that lack of curiosity carries costs and overhead expenses as well as benefits. (Bijker and Law 1992, 2.)

[4] Transparency in this sense means that infrastructure "does not have to be reinvented each time or assembled for each task, but invisibly supports those tasks" (Star and Bowker 2002, 152); the archetypal of this, in developed countries, is domestic electricity supply.

As well as being materially unseen and intangible in use, probably the most effective way that Internet infrastructure is made invisible is through its subtle disappearance from people's consciousness. As is well noted by scholars interested in the social shaping of technology, once an infrastructure becomes commonplace, people do not much care for how it is produced, for they exhibit "a tactical lack of curiosity" according to Bijker and Law (1992, 2). It becomes a 'taken-for-granted' feature, fading into the background of everyday life. Infrastructure is something you notice more by its absence than its presence.

From being a novelty in the mid 1990s, the Internet has quickly become culturally naturalised, with email addresses and websites part of common vernacular. Concerns about 'digital divides' notwithstanding, many businesses and government agencies now presume that *all* people have Internet service and are sufficiently conversant with it to obtain information and perform transactions online. (Arguably, connotations of ubiquity and universality is, in part, constructed through the particular kinds of worldwide mapping of Internet penetration statistics by some organisations; see analysis in chapter five.) Such everyday social-cultural familiarity is clearly bound-up with transparency in use. As infrastructures become more transparent (and more reliable, affordable and universally available), so they morph in character from desired conveniences to a necessary and seemingly naturally-given part of the lived environment.

This is often conceived of as a process of 'black-boxing' in which infrastructures are "treated by users as unproblematic and 'closed' sociotechnical artefacts that [can] be relied on without much thought" (Graham 2000, 184). One might argue that the best infrastructures are those that are so 'black-boxed' they are not noticed at all; they are also the most powerful, able to affect deeper or wider ranging reorganisations of socio-spatial relationships without scrutiny or resistance (again, electrical power supplies serves as an archetypal case). Indeed, one way of assessing the extent to which technologies, including the Internet, have moved 'backstage' and been 'black-boxed' is by measuring the degree of dependency people are willing to place on them. Such dependency is exposed in the disruption caused when infrastructures temporarily fail, for whatever reason (e.g., the large degree of inconvenience to everyday activities caused by power cuts).

4.2.4 Occlusion through institutional normalisation

Large infrastructures are produced by institutions and their ongoing production requires huge amounts of mundane, easily-overlooked organisational work (construction plans and maintenance schedules, operational staffing arrangements, business processes, financial management, technical standards, and so on). Internet networks are as much an outcome of the institutional practices as they are the result of physical wires.

Yet this kind of institutional work tends to become normalised, bureaucratic and anonymous. Infrastructure invisibility is manufactured institutionally then, by obscure regulatory structures that make it hard to discern sources of decision-making power, by complex pricing models that hide real costs and deliberately opaque ownership structures which make it unclear who controls companies. Ultimately, the complex institutional power structures underlying the supply of the Internet into people's homes contributes to making the infrastructure invisible. (Many of the companies examined in chapter six who run large parts of the Internet networks are obscure because they do not sell services to end-customers.)

Institutional working is itself is bound within the prevailing political-economic structures. Through much of the second half of the twentieth century utility infrastructures (electricity, water, telephone, transportation networks) were operated within monopolistic state ownership structures. Generally, these had clearly established remits and strong public identities for the infrastructure they managed (even if they were not well liked, e.g. British Rail). Since the 1980s, this institutional unity in provision has been deliberately broken apart - so called 'unbundling' or 'deregulation'- through processes of marketisation, privatisation and regulatory liberalisation. Such fragmentation means there is a lack of a constituted, agreed institutional identity for utility providers. In the case of the Internet, whose job is it to keep the infrastructure running? Graham and Marvin (2001) characterise this shift as a 'splintering urbanism', arguing that it is giving rise to "'premium networked spaces' that are customised precisely to the needs of powerful users and spaces, whilst bypassing less powerful users and spaces" (Graham 2000, 185). Internet provision is a prime example of such premium networked spaces, with its pricing, quotas and differential bandwidths.

Another significant element in this invisibility of institutions owning and running the infrastructures of the Internet is the obscurity of the workers who do this work. The skilled labour force required to build and operate the Internet is largely invisible, and when acknowledged they are often denigrated as just 'technicians' in comparison to other more attractive occupations associated with the creative industries of new media. This aspect of the 'hidden' workforce in information infrastructures is not new, as Downey (2001) shows in relation to the telegraph era.

4.2.5 Implications of infrastructure invisibility

> Infrastructure can be dullest of all topics. It can also be the most important. Infrastructure defines the basis of society; it is the underlying foundation of the facilities, services and standards upon which everything else builds. (Norman 1998, 55.)

The above dimensions of infrastructural invisibility have consequences, both pragmatic and political, for understanding the nature of the Internet. Firstly, from a practical point of view it means infrastructures tend to be little studied within social sciences. They are easily overlooked by scholars and deemed to be insignificant elements in wider analysis or are seen as 'mere' technicalities with little scope for socially informed research. Hillis (1998, 544), for example, argues that infrastructure invisibility across several registers has been the key reason why telecommunications have received scant attention by the human geography discipline[5]: "[f]or a discipline firmly rooted in an empirical and visually dependent understanding of the facts, too often, if it can't be seen 'it's not geography'."

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[5] There have been some noteworthy academic attempts to understand the physical construction and geographical embeddedness of network infrastructures, in spite of the varying dimensions of invisibility, e.g., Board *et al.* (1970); Gottmann (1961);Graham and Marvin (1996, 2001); Hugill (1999); Mitchell (1995); Townsend (2003).

The failure of much of the social sciences to take a serious interest in infrastructures is compounded by the lack of published and comprehensible documentation of them. This is particularly the case with the Internet, with available data being partial, spatially incomplete, fragmented organisationally and often held to be commercially confidential (cf. Grubesic and Murray 2005; Jordan 2001). In relation to network maps for commercial promotion, chapter six discusses the impacts of partial and missing traffic data for misunderstanding the nature of Internet infrastructure growth. Furthermore, as an infrastructural entity, the Internet is essentially made intractable because of its undocumented presence in standard government statistics and on general reference mapping. For example, the terrestrial fibre-optic cable systems which sustain the Internet are not present as a layer in published topographic map databases (e.g., in Ordnance Survey's MasterMap product in the UK)[6]. Being unmapped in this way is, in many respects, tantamount to being invisible for analysis[7].

From a political perspective, critical studies of infrastructures are made harder because of the ways in which institutions deliberately keep them as 'black-boxed' systems, to keep people from easily observing (and questioning) their design and operational logics. Invisibility of the infrastructure provides an effective cloak under which dubious or iniquitous practices can be safely carried out by institutions owning and operating them. The lack of critical studies of Internet infrastructure mean intensifying bias in the ongoing production of networks that widen social difference and inequalities across space are unchallenged. It also precludes informed discussion of ways to build and operate infrastructure differently.

[6] Utility engineering departments do have facilities maps showing pipe and cable routes but these are typically not available to the public and in many cases are incomplete and of varying degrees of accuracy.

[7] As noted in chapter six, this limit has meant some academic and policy analysts have been overly reliant on the vagaries of network marketing maps produced for commercial promotion as their source of primary data on the extent of Internet infrastructures.

4.3 The role of verbal and visual metaphors

The generation of popular explanations of the Internet involves the classification and conceptualisation of an unfamiliar phenomenon (i.e., extensive but invisible infrastructures which support novel forms of interactive media) into a set of well-known categories. This process can be effectively accomplished using metaphors, which constitute an important and pervasive form of figurative speech, fundamental to human language and which structure cognitive experience (Lakoff and Johnson 1980). Here I consider verbal metaphors first, followed by a discussion of common visual spatial metaphors, used to represent, imagine and 'explain' Internet infrastructures, thus, at least in part, overcoming its multidimensional invisibility.

4.3.1 Linguistic spatial metaphors

> The expanding lexicon of the Internet ... is not only replete with, but actually *constituted* by, the use of geographical metaphors. (Graham 1998, 166.)

Metaphors are linguistic tools that facilitate understanding of a unfamiliar subject by bringing another, more familiar, concept in conjunction with it. According to Lakoff and Johnson (1980), metaphorical schemas ground the conceptual structures of a novel domain (target) to a known, physical one (source). The metaphor works as a transfer of concepts from source to target, in which the transferred, familiar concepts interact with the new unfamiliar context, highlighting its nature and producing effects in terms of potential shifts in meaning. As Sawhney (1996, 292) argues, metaphors "create a 'stereoscopic vision' which allows for simultaneous viewing of an idea from two or more points of view." The unfamiliar motorcar when it first appeared in 1880s, for example, was explained as a horseless carriage, thereby grounding the unknown by proposing that it can be seen as being like the common horse and cart. The insight generated by a well-chosen metaphor comes from the point of *interaction* between familiar concepts and unfamiliar contexts. Metaphors create an image that is usually far from the actuality of the subject; for example, the reality of Internet access via dial-up modems in the early 1990s was at odds with 'highway' metaphors, and yet effective metaphors can pervade the popular imagination through reproduction in the media, being endlessly circulated and refined, so that they become a natural and invisible part of language and thought. Furthermore, metaphors become part of defining the cultural contexts of communication and play a major role in the legitimisation of certain social values and in the denial of others. The choice of metaphors can reveal as much about the speaker as what they are actually talking about.

Metaphors can work as self-fulfilling prophecies in which the phenomena so described gets progressively remade to fit its dominant metaphor. "The metaphors that are used to study an emerging technology", Sawhney (1996, 293) notes, "usually end up influencing the shape it takes." This can be seen for example, in the legal frameworks enacted to regulate the Internet, which are based, in significant part, on metaphors from a transportation context relating to physical movement of goods (see below). The conceptual framework from which particular metaphors are drawn is important because they impart certain properties and favour certain implications. Contrast, for example, conceptualising Internet infrastructure as media with the associated range of broadcasting metaphors, instead of the more utilitarian transportation one.

Metaphors must, therefore, be read as political because their linguistic power can effect social change in terms of the way a new phenomenon is perceived, in the service of certain interests. Adams (1997, 156) calls this effect a "cognitive jolt" that makes people stop and think in a new way, and it can be used to destabilise accepted norms. Metaphors can also be deployed persuasively to contain and normalise threats to powerful interests from new phenomena, such as a disruptive technology like the Internet. Metaphors, then, are a contested domain of political action because they affect how people talk about the world which, in turn, affects the way they relate to it.

In circumstances where there is "high uncertainty, missing data, unclear goals and poorly understood parameters" (Klein 1987 quoted in Sawhney 1996, 292), the most productive means of explanation of a new technology can often be through metaphors and analogies. This was the case with the Internet in the early 1990s when it was in its social 'discovery' phase of development in Western consumer societies. It is important to think about the politics lying behind the work metaphors were being employed at this time.

Metaphors from many different conceptual frameworks have been actively deployed to characterise the Internet. For example, the Internet as a living organism (such as a tree, a body or brain); the Internet as a city (with streets, towns halls and suburbs); the Internet as a marketplace (with online shops, virtual money, and e-trading); the Internet as written text (with its letter metaphors of web pages email, addresses and signature files). The map and mapping practices related to navigation were themselves also a prime source of metaphors for explaining the Internet. Metaphors from multiple domains were employed simultaneously, often in competition to dominate a discourse. The result was a confusing ecosystem of metaphors (see Palmquist 1996), being combined together and clashing against each other in confusing, sometimes creative ways (e.g., the notion of information presented as a 'Web page' combines the organic framework with a book-bound analogy).

Each of these metaphorical domains highlights certain aspects of the Internet, downplays some and hides others. Some clearly owe allegiance to U.S.-centric domination of the Internet's infrastructure development and media-driven popularisation; for example, the large number of 'frontier' related metaphors. This metaphorical domain is seen as foundational to many American cultural myths, pregnant as it is with complex connotations of social autonomy and political conquest (cf. Adams 1997; Yen 2002). As example in 1990, Mitch Kapor and John Perry Barlow, co-founders of the Electronic Frontier Foundation, a U.S. interest group that works for Internet free speech, wrote: "In its present condition, cyberspace is a frontier region, populated by the few hardy technologists who can tolerate the austerity of its savage computer interfaces, incompatible communications protocols, proprietary barricades, cultural and legal ambiguities, and general lack of useful maps...". The nature of social and spatial relations implied by this kind invocation of the frontier (zone beyond legal control, self-reliance, boundless opportunities for risk takers and so on) are seen as ideals, by some, for the kinds of new technological opportunities the Internet promised in the early 1990s. It also "supports an often-made claim that cyberspace is different from real space, and that government should generally refrain from regulating the Internet" (Yen 2002, 3). Yet the frontier is as much a romantised myth of progress that consciously elides the very detrimental experiences for many living on the frontier, with its profiteering, rough justice, racial prejudice and casual violence.

The notion of a frontier also has direct and significant connections to cartography. The act of mapping frontiers begins to render these uncertain spaces as definite lines (a classic example from history being the Tordesillas line that divided the New World for Portuguese and Spanish conquest). Inscribing the frontier begins to formalise its existence and representations necessarily fix its position. Mapping as an act of enclosure transforms frontiers into known borders, able to separate inside from outside, to determine who belongs and those who do not. In some senses all that world maps are semiotically is just frontier signs, but quite problematic for all their connotations of solidity and reality; as Black (2000, 218) observes: "[c]learly contrasting primary colours and firmly delineated frontier lines do not describe adequately or accurately problems of multiple allegiances, overlapping jurisdictions and complex sovereignty…". Also, on the ground, at the frontier line there is often no physical trace to be seen yet the map has real force in construction of territory.

Besides the 'frontier' metaphors, another noteworthy collection of spatial metaphors applied to the Internet uses familiar architectural places (e.g., library, shops, farms, etc). Others characterise the Internet in terms of container-like space (e.g., rooms, sites, malls, communities, cities, spheres, worlds and, of course, cyberspace itself). The metaphors in the container-spaces framework are somewhat more abstract than others, but have nevertheless proved to be particularly potent in defining the Internet as a territorial system, with discrete locations and a bounded sense of inside / outside.

Metaphors built around architectural places are also very common, subtly suffusing throughout Internet imaginary. Familiar domestic environments of the home and work have been metaphorically co-opted to give concrete cognitive forms to invisible Internet infrastructures and their intangible media (homepages, digital libraries, virtual classrooms, server farms and so on). There are almost endless combinations of them and they have been nested together by function or linked thematically. Internet evangelist, Howard Rheingold, who was the lead propagator of the 'virtual communities' movement (itself a potent metaphor), gave a vivid description in the early 1990s of the social forms of part of the Internet, by mixing together multiple architectural-place metaphors:

> "... a place for conversation or publication, like a giant coffee-house with a thousand rooms; it is also a world-wide digital version of the Speaker's Corner in London's Hyde Park, an unedited collection of letters to the editor, a floating flea market, a huge vanity publisher, and a collection of every odd special-interest group in the world." (Rheingold 1993, 130.)

The coffee house is particularly interesting as a spatial metaphor with assorted meanings. It is applied to describe the social nature of cyberspace, imagining the Internet as an ideal venue for particular kinds of discourse and discussion. The coffee house has many connotations in European intellectual thought and public life, being regarded in the eighteenth century as one of the wellsprings of the Enlightenment, a place from which new ideas in science and politics emerged and could be openly debated. It was a place to meet like minded thinkers, share scholarly gossip, read political pamphlets and hear about new scientific discoveries from the men themselves. The coffee house was a public place where you could be seen to be in serious conversations, yet it also offering room for private dialogue (but with the risks of being overheard). Besides discourse, it was also a space for where business could be conducted, and contributed to the raise to form new forms of capitalism and entrepreneurship which were distinct from traditional sources of wealth and power – the church, the king and landed aristocracy.

Yet for all the progressive idealism bound-up in the notion of coffee house culture – which obviously made it an apposite metaphor to apply to mould the, then, formless Internet for 'cyber-utopianists' like Rheingold – it implies certain kinds of acceptable context and social relations. The most obvious being around class and gender. The coffee house was not welcoming to all, it was only a convivial space only for certain class of men engaging in serious talk. It was distinct from the ribald alcoholic atmosphere of the (working class) public house or the trivialities of chatter of the (feminine) tea shop. While the coffee house metaphor connotes openness, it has distinct social and material boundaries that create categories of insiders and outsiders. It was also a space of labour relations with people serving and people being served. It was only democratic for those on the one side of the counter and with the level of income to be able to afford to indulge in the new taste for coffee, an expensive luxury, indicative of sophistication and certain social status. Even today coffee drinking implies a different set of behaviours and identities to, say, lager drinking, as does the use of the Internet which for some is about edification but it also offers prurient recreation for others.

A thorough application of architectural imaginary to metaphorically 'explain' the nature of Internet infrastructures is given in the writings of William Mitchell (professor of Architecture and Media Arts at MIT). His influential book *City of Bits* (1995) published in the midst of the Internet 'take-off' was one of the first to analyse the significance of emerging Internet infrastructures for the built environment. Mitchell's (1995, 107) thesis claimed that "[c]omputer networks [will] become as fundamental to urban life as street systems. Memory and screen space become valuable, sought-after sorts of real estate." The highpoint of such urban-centred metaphors came in the late 1990s with popularity of 'virtual cities', some of which were 'grounded' with real-world equivalents while others were purely imaginary (Aurigi 2005). This has now been large usurped by the rise of placeless social networking focused around individual ego rather than communal life, as seen in the popularity of services such as Facebook and Myspace.

The widespread application of such architectural and city metaphors clearly has utility in making foreign media-based environments feel familiar, yet they are not innocent (mere convenient linguistic devices). The over-reliance on such metaphors, Graham (1998, 167) argues, "actually serves to obfuscate the complex relations between new communications and information technologies and space, place and society". How far is a digital library really like a 'real' library, for example, in relation to issues of access, usability and privacy? More subtly, these metaphors bring with them the oppressive potential of manmade environments, with their established power geometries of ownership and rules of access and exclusion. As Adams (1997, 167) notes: "We might worry that the primary function of virtual architecture would be a kind of containment, in which there was no longer an 'outside' and populations were everywhere contained and subjugated."

Beside place-based 'nouns' to describe the forms of the Internet, the action of using the network is frequently described in terms of spatial 'verbs' of physical movement and embodied travel. The lexicon of such metaphors includes: surfing, navigating, exploring, homesteading. (They are quite different from ways of describing other media use, e.g., book reading and television viewing.) These metaphors of movement also encompass spatial notions of following paths, getting lost, hitting dead-ends and the discovery of new places. Online activity draws from "every imaginable environmental situation, suggesting not simply a virtual place but an entire virtual geography" (Adams 1997, 155).

Closely allied with the spatial metaphors of movement used to explain participation in computer networks, are the transportation-oriented metaphors of pipes, routes, rails and especially roads used to analogise data flows. Transportation metaphors conceptualise the wider effects of the Internet infrastructure not as a virtual territory but as a means to *traverse* real territory, typically at great speed. (The nature of maps of transportation and travel contribute to this, with their highlighting of network above topography, see discussion in chapter six in relation to marketing maps.) The implication of this metaphorical approach to infrastructure, is that Internet's role is primarily about improving efficiency in shipping data, which is treated as a bulk commodity to be rapidly moved from point-to-point. The most common of these traversal metaphors is, of course, the 'information superhighway', which coupled the nascent Internet directly with ingrained American notions of automobility[8]. At the end of 1993 the highway metaphor was invoked directly as a political ideal of

[8] Of course mapping played a part in the rise of car culture, representing the landscape in ways amenable to drivers as the analysis by Akerman (1993, 2002) has shown; see chapter six for discussion.

what the Internet should become, as then U.S. Vice President Al Gore asserted: "Today, commerce rolls not just on asphalt highways but along information highways" (Gore 1993, 3).

Coming from a strongly techno-utopianist perspective, Gore championed a vision of universal public access to the Internet, explaining that a helpful way to think about such an infrastructure was as "a network of highways -- much like the Interstates begun in the '50s. Highways carrying information rather than people or goods" (Gore 1993, 5). Although these new 'information highways' would be built by private capital, the clear analogy with road infrastructures of the past implied that the government had a positive social remit to oversee development of the Internet, to ensure equality of provision and that all places are connected. Furthermore, the government had a duty to set the framework of the market (equivalent to the highway code) to ensure "there will be a 'public right of way' on the information highway" (Gore 1993, 10), rather than a private network, such as cable television.

The 'information superhighway' metaphor proved to be a potent choice and it quickly grew to be one of the dominant metaphors applied to 'explain' the nature of Internet infrastructure in the mid 1990s, endlessly promulgated in media coverage and in government reports[9]. While the socially progressive goals of Gore's vision were clearly articulated, the choice of the highway metaphor itself imposed distinctly instrumental notions on the future shape of network infrastructure: it would essentially be a flat hierarchy, accessible only at certain junctions, with people as passive drivers only able to go in certain directions[10]. Highways are, after all, built for efficiency and this has been paralleled in the Internet's subsequent development. As such the 'superhighway' had a "strong aura of linearity" (Sawhney 1996, 304) and can be read as an extension of the individualistic economic model over the communitarian one that dominated much of the Internet's nascent development in the late 1980s (emphasised, for

[9] The British Library catalogue lists 71 books which contain the phrase 'information superhighway' in their titles. Thirty-four of these books were published in 1995.

[10] Interestingly, this passivity was itself subverted metaphorically when commentators argued users should be allowed the freedom to 'go off road'.

example, in Rheingold's deployment of the 'virtual community' metaphor). Sawhney (1996, 307) argues that at its heart, the highway metaphor is reductionist: "[t]he ritual or the communal aspect of human communication is almost totally neglected" in favour of maximising the transfer of information.

The subsequent demise of the 'highway' as a meaningful explanation of the Internet shows how metaphors are contingent, partial and contestable[11]. By the end of the 1990s the 'superhighway' metaphor had become a thoroughly clichéd moniker and was being used most often in a derisory sense. It was also deployed counter-factually as commentators pointed up the reality of network 'dirt tracks' outside the developed core in discussion of global Internet diffusion and digital divides (The dichotomy of diffusion versus divides is considered in depth in chapter five in relation to the role played by global scale mapping of statistics on Internet globalisation.) As Sawhney (1996, 300) notes: "The initial metaphors basically function as provisional hypotheses which can be held only as long as the facts permit". As more people experienced the Internet first hand, and used it productively for everyday tasks, the appeal of the 'highway' metaphor waned, to be replaced by more organic metaphors of Web environments and social networks.

4.3.2 Visual metaphors for Internet infrastructure

Metaphors are not just verbal constructs, they can equally be fabricated through visual imagery. Given that much of modern experience is constructed 'second-hand' through visual media and marketing imagery in print and on screen, in many respects visual metaphors enjoy even greater political significance in defining 'what the Internet is like' than their verbal counterparts. This is well recognised by designers of advertising who strive to invent new metaphors and them taken up into circuits of cultural communication (see De Cock *et al.* 2001; Goldman *et al.* 2003).

[11] Of the 71 books with 'information superhighway' in their title catalogued by the British Library, only four have been published since 2000.

As noted in the introduction, the Internet lacks a single, obvious, physical representation that people experience for themselves, which could be moulded into its defining visual metaphor[12]. Uncertainty on the 'natural' visual shorthand for the Internet for a general audience is apparent; for example, in newspaper coverage in the 1990s that juxtaposed quite different image types. A significant proportion of these visual metaphors called upon explicitly spatial constructs to make the Internet appear as a tangible entity or to place it within familiar geographical contexts. Here, I audit and interpret the significant types of visual spatial metaphor that imagined the Internet infrastructure in four categories: (i) as a network of wires, (ii) as flows around the globe, (iii) as machines for moving objects and, lastly, (iv) as abstract clouds and organisms.

4.3.2.1 Wiring visions

The commonest visual analogy to explain the Internet as a spatially extensive infrastructure is a physical network of wires. Very often this imagery uses arc-node route lines plotted on top of a geographical base map such as the illustration of undersea cables shown above (Figure 4.1). As such they are part of a lineage of sketching the pathways of human movement stretching back throughout cartographic history to the earliest maps scratched in the sand. Route maps have been applied to telecommunication systems since they emerged in the mid nineteenth century, as shown in chapter six. As a visual analogy they demonstrate the material reality of the infrastructure in relation to a familiar and trusted geographical backdrop and are most widely deployed in commercial promotions as the analysis in chapter six demonstrates.

The 'wires-on-the-world' visual analogy also underlies a great deal of 'maps of cyberspace' produced (see examples in chapter three). They can be produced at different scales, from local maps in the form of wiring schematics for a neighbourhood or an individual corporation, up to global scale maps of transcontinental cable systems (Figure 4.1 above). National and global scale

[12] Here, I am distinguishing the Internet as an infrastructure, from the consumption of particular Internet services. The Internet as a service is typically represented visually by screenshots of particular media interfaces, such as websites 'in action' (e.g., e-commerce was often 'explained' metaphorically by a visual image of Amazon.com's homepage).

maps of infrastructure are frequently produced as part of network marketing (see chapter six). The level of realism in plotting the routes of lines can be varied and in many network maps the routes are logical links between end nodes and bear no relation to the physical pathway of the cable on the ground. Increasing the degree of topological generalisation of route lines morphs the Internet from conventional geographical network mapping into variable scale-distortion subway maps and non-geographical circuit diagrams (Figure 4.3).

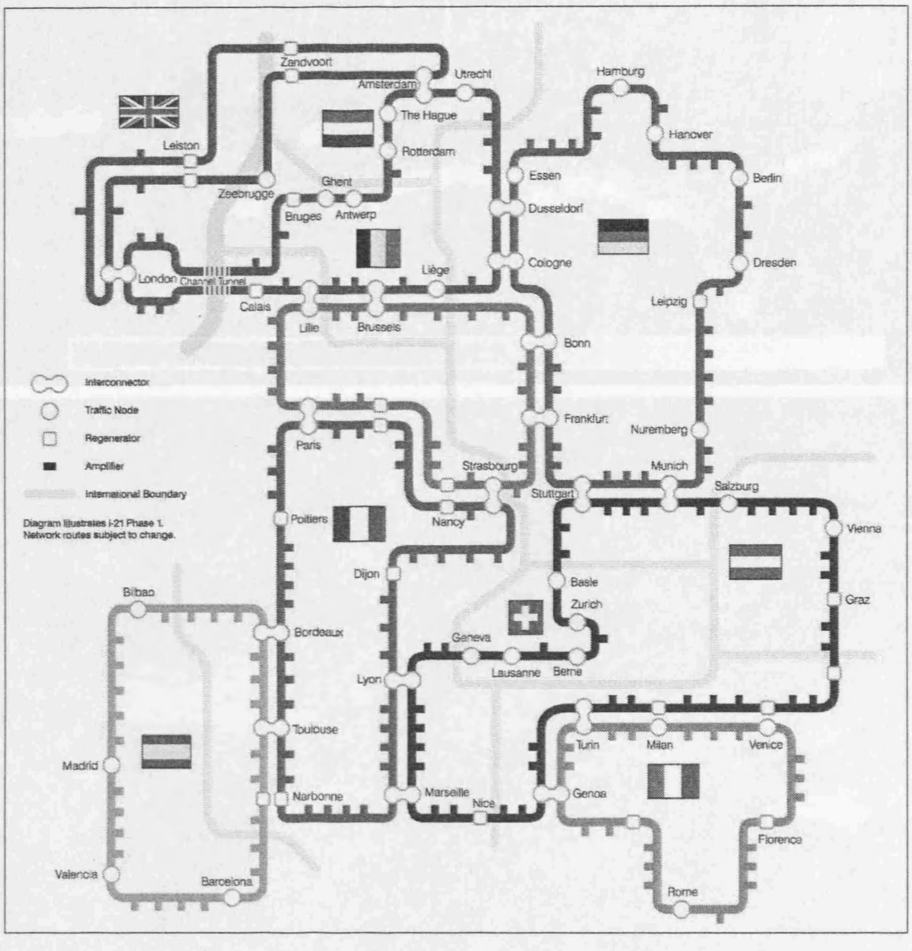
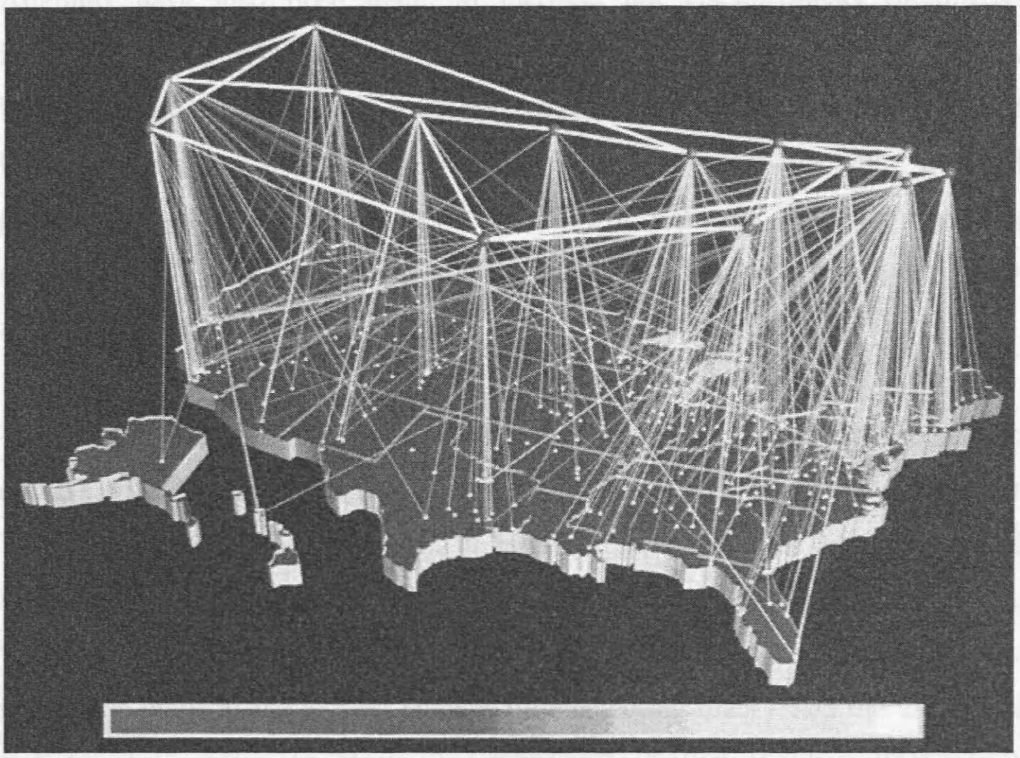


Figure 4.3: Internet infrastructure explained using the subway maps metaphor. This example was produced by Interoute in 2000 to promote its European network. (Source: www.interoute.com.)



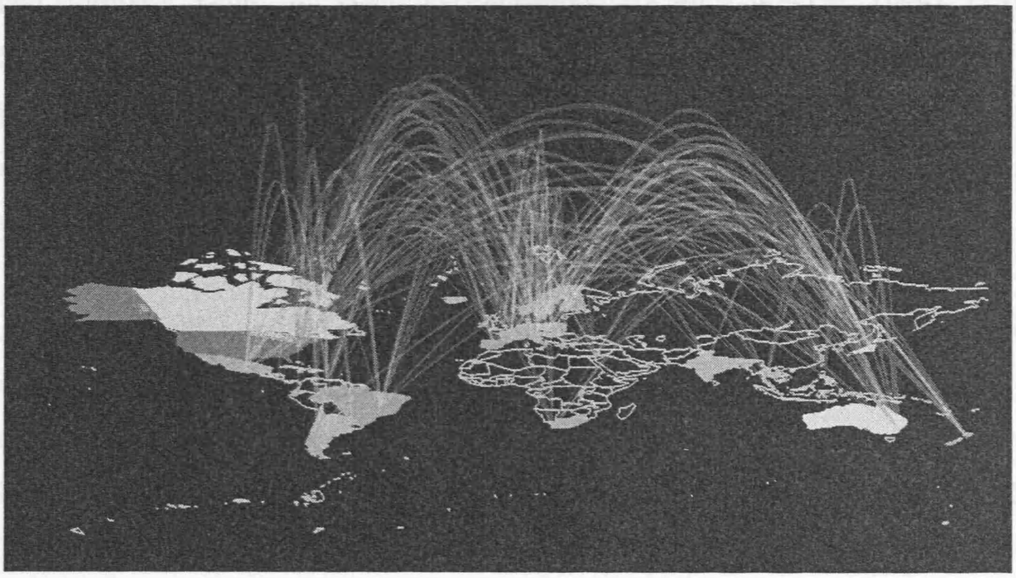


Figure 4.4: Top: A dazzling network of wires provides the central metaphor for a visualisation of NSFNET infrastructure produced by Donna Cox and Robert Patterson, National Center for Supercomputing Applications, University of Illinois Urbana-Champaign in 1994. The figure itself is a single frame from a short movie of the growth in traffic on the NSFNET backbone (source: NCSA 1994). Bottom: The metaphor of 'arcs across the world' creates a visually arresting image of Internet traffic flows between fifty countries as measured by the NSFNET backbone for a two hour period in February 1993 (source: Cox et al. 1996).

Attempts have also been made to increase the visual impact of Internet infrastructure maps by stringing the wires in three dimensions. One of the best known examples is the NCSA (1994) visualisation of the NSFNET network backbone (Figure 4.4 top). The network is imagined glowing white hot with pulses of data-light in the inky dark sky, a powerful presence radiating connectivity down to the nation. This striking image has been widely circulated and reproduced.

The NCSA visualisation is also interesting as it blends together the iconography of the engineer's wiring diagram with the thematic display of statistical mapping. The connecting lines from ground to network in the sky are colour coded to indicate the volume of traffic flowing from individual sites onto the network. "Icons such as this rely on the associations the audience makes between familiar forms- the maps of the United States with connecting lines – and the unfamiliar and formless realm of electronic networks" (Kallick-Wakker 1994, 313). Showing flows, rather than just the wire routes of a network, opens up many possibilities for metaphorical invention. Although, this approach is unusual and most network marketing maps are much more convention (see discussion in chapter six).

Another visualisation from the mid 1990s illustrates well the potency of visual imaginary to capture the essence of the Internet by displaying real flow data in three-dimensions (Figure 4.4 bottom). The Arc-Trans map of global traffic flows imagines the Internet as a set of fountain-like arcs of light traversing the world. The colour, link style and height of the arcs encode statistical information. It is important to realise that the arcs are not denoting network links per se but symbols plotted between capital cities to represent aggregate statistics on inter-country traffic flows. The map was produced by the researcher Stephen Eick and colleagues at Bell Labs-Lucent Technologies in 1996 as part of a project to create compelling 2D and 3D visualisations to understand network data flows. It is a screenshot of an interactive visualisation tool they developed called SeeNet3D (Cox *et al.* 1996). Of all the maps and diagrams catalogued in the *Atlas of Cyberspaces*, the 'arcs-across-the-world' metaphor at the heart of this image is far and away the most requested one for reproduction. In this manner, a few of most the visually impressive and compelling maps begin to define how the actual infrastructure of the Internet is perceived. Yet, it is not an innocent image. As Harpold (1999, 5) points out, the underlying metaphor draws its energy from "visual discourses of identity and negated identity that echo those of the European maps of colonized and colonizable space of nearly a century ago."

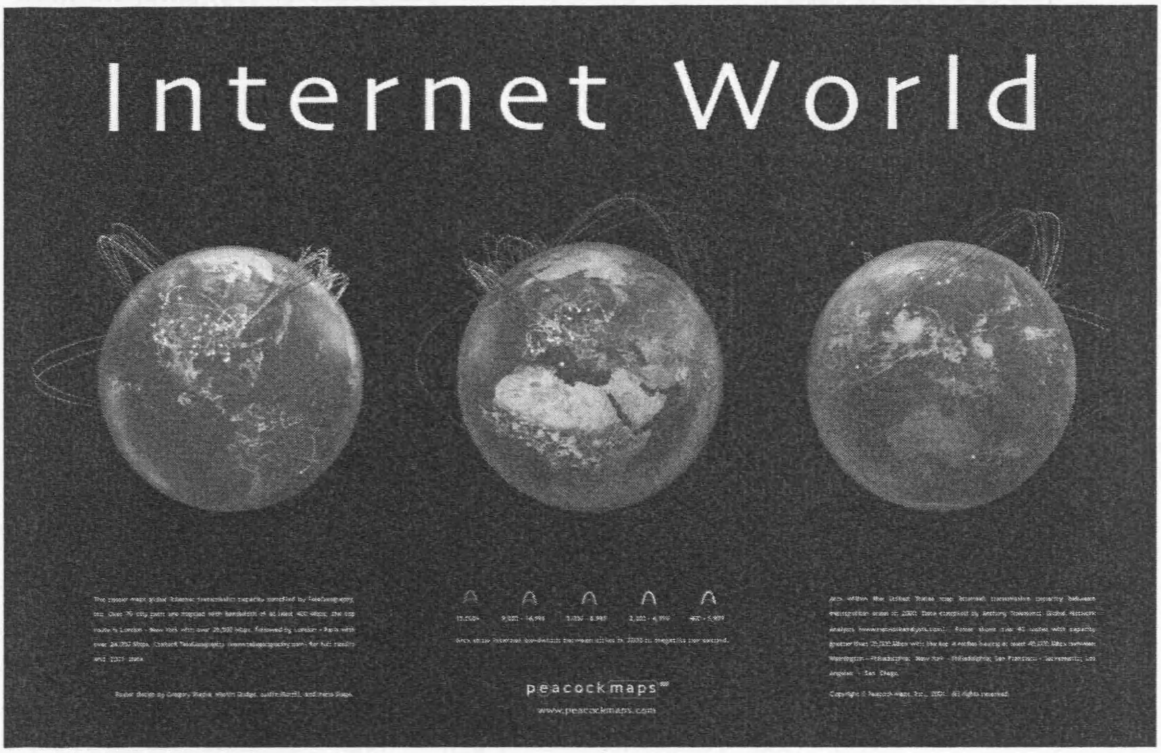


Figure 4.5: An effective example of the globe metaphor used to visualise Internet bandwidth statistics. It was conceived by Gregory Staple and Martin Dodge for a commercial poster in 2001. (Source: Peacock Maps, <www.peacockmaps.com>.)

4.3.2.2 Global visions

The earth globe is a dominant visual metaphor in Western contexts. The capability to command global vision is intimately associated with modernist culture. The globe has symbolic power because "we all assume for ourselves the position that most peoples have historically reserved for God. No longer confined by the local worlds of our direct experience, the conception of the globe allows us to make geography, for us to predict and then to discover new spaces, new worlds, new peoples" (Cosgrove 1989, 13). The globe has become integral in the imagery of many elements of corporate capitalism (e.g., aviation, telecommunications), as well as the key icon for the environmental movement (the 'Whole Earth' idea) (Cosgrove 1994). Universally displayed, often to the point of cliché, it is *the* iconic symbol of a business or institution with world-wide operations or aspirations, and potent for representing internationalism in political campaigning (cf. Edsall 2007) The global perspective, derived directly from the arms-race technical capacities in satellite monitoring, is also bound up with the militaristic gaze of command and control.

The globe as a visual metaphor is immediately recognisable[13]. It has become a staple visual metaphor for the Internet, with network arcs or data flows being wrapped around the world (good examples visualising aspects of the Internet infrastructure on the globe include: Cox *et al.* 1996; Lamm *et al.* 1996; Munzner 2000). Globes were used as the central motif on a poster called *Internet World*, produced by Peacock Maps in 2001 (Figure 4.5). Three views on the Earth show curving lines between capital cities to represent the available international Internet bandwidth. The height of the arcs above the surface of the globe is a function of distance. This is an imaginary view of the Internet, as if seen from a God-like position, with a dense mesh of arcs criss-crossing the USA from coast to coast, along with higher, longer transcontinental tunnels curving around the globe. The points on the globe *without* arcs are evident as well.

[13] It is also highly functional in graphic design terms because it can be rendered in myriad forms from a naturalistic 'blue planet' to a very stylised image conjured forth by a sparse grid of curving lines.

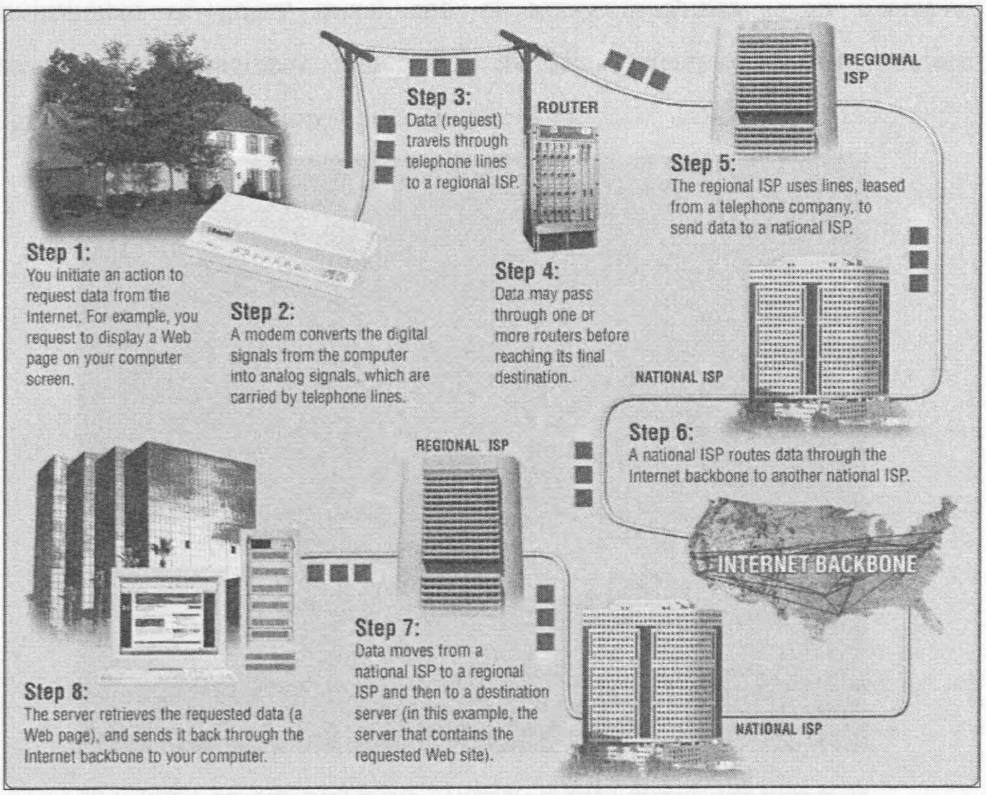


Figure 4.6: A step-by-step machine metaphor using photographs of hardware linked buildings to 'explain' basic Internet networking concepts (source: author archive).

4.3.2.3 Machine-like visions

In a very different mode to maps and globes, the Internet has also been spatially envisioned as a machine with working parts which handle and transport items of data. Representing the Internet through such mechanical metaphors can be particularly helpful in an educational context (e.g., Gralla 2003). The simplest of these approaches use photographs of actual network hardware or iconic images of equipment. These visual elements are sometimes presented as a systems model showing conceptually how a message is transported - what can be thought of as a 'tin cans and string' diagram (Figure 4.6).

More elaborate machinic metaphors imagine the Internet as a 'world-in-miniature' inside the infrastructure. For example, *Warriors of the Net*, a short animated film, shows in a jovial, non-technical way, how the Internet works internally by following the journey of data packets through different parts of the infrastructure (Elam 1999). Its underlying metaphor shows an industrial environment of grimy metal and of noisy machines – an example of 'steampunk'[14] imaginary, rather than the slick, clean cyber-infrastructure of digital electronics and fibre-optics (Figure 4.7).

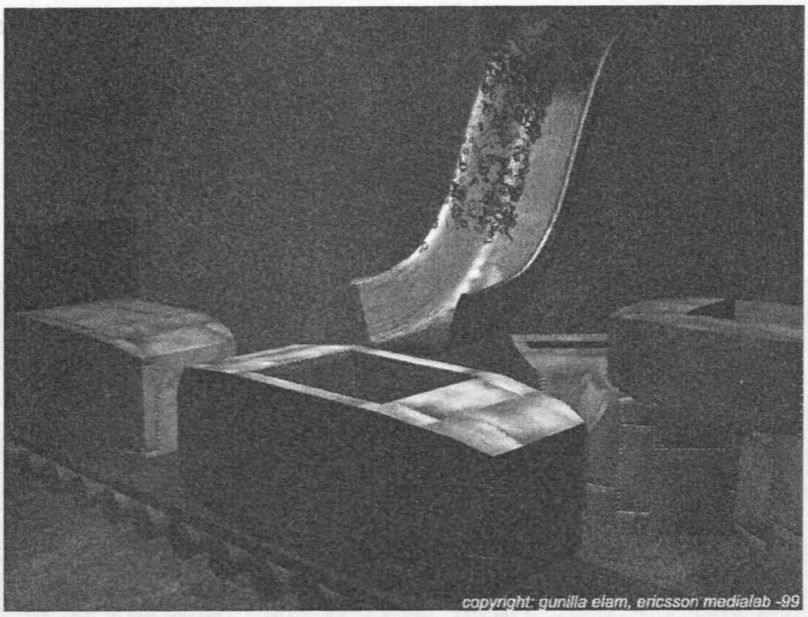


Figure 4.7: Stills from *Warriors of the Net* film, using a mechanical metaphor to explain the inner-workings of the Internet. Empty IP data packets, represented materially as large steel trucks, are filled with loads of data in the form of letters (top). They are then carried aloft in a freight elevator for entry onto the LAN (bottom). (Source: Elam 1999.)

[14] The visual aesthetic of 'steampunk' (named after the cyberpunk genre of science fiction) imagines advanced societies based on machinery (usually steam powered) rather than micro-electronics (cf. Gibson and Sterling 1992).

Rather than just imagine infrastructure spaces in mechanical terms, others have actually created physical machines to model the Internet's concept. For example, Japanese media artist Kouichirou Eto created 'a hands-on model of the Internet' that simulates physically the outward appearance of digital bits and data routing. As he succinctly notes: "[b]alls roll, and the workings of the Internet are revealed."[15]. Infrastructure is thus made tangible as an analogue model, a real spatial metaphor of the Internet that people can see, hear and touch (Figure 4.8).

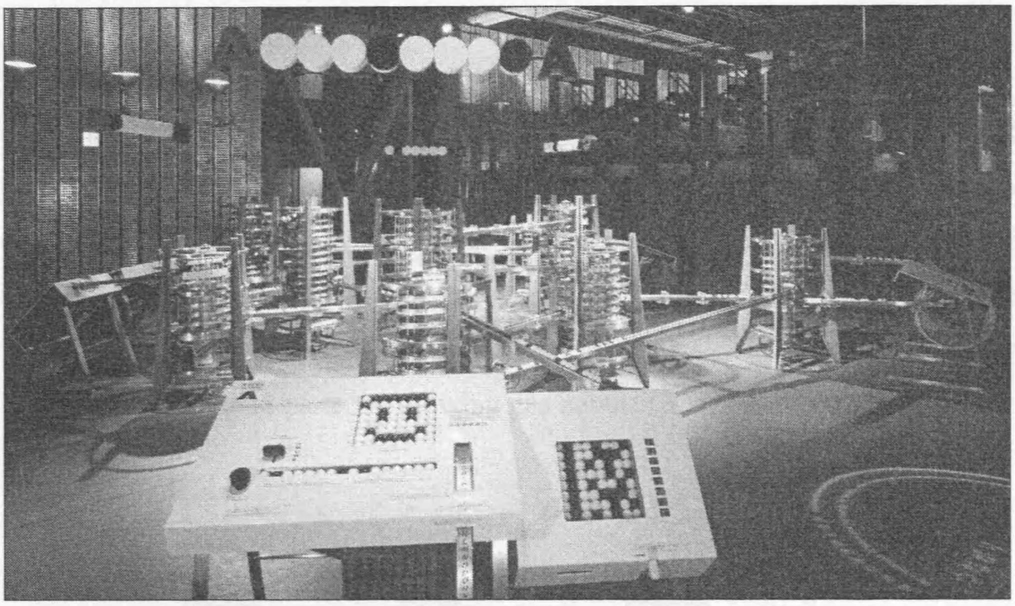


Figure 4.8: Kouichirou Eto's physical model of the Internet exhibited in National Museum of Emerging Science and Innovation, Tokyo. The control panel in the foreground is used to compose short messages by hand using black and white balls to encode letters in binary. Users then watch their message move through the machine, accompanied by suitably mechanical sounds of clanking metal and clinking of ceramic balls. (Source: <http://eto.com/2001/PhysicalInternet>.)

The metaphorical use of the movement of real objects to suggest the invisible workings of the Internet is also common. The power and speed of flows of data through network has often been visually connoted through images of blurring vehicle lights on highways or a soaring flight over a city at night. The feeling of physical movement experienced by the viewer captures the idea of flow through networks. For example, Goldman *et al.* (2003, no pagination) highlight a MCI

[15] Source: <http://eto.com/2001/PhysicalInternet/>.

WorldCom advert using this kind imagery, noting: “Here is the cyber-scape of the moment, not simply a symbol of a future that is upon us, but a functional conduit, the veins of a network that like a river flows through us, connecting us.” Intertwined with the evocative imagery of movement and the power of incredible speed is the utopian message of transcendence over the tyranny of place and time, commonly used in promotional rhetoric of the ‘New Economy’ (De Cock *et al.* 2001).

4.3.2.4 Abstract visions

The last category of spatial metaphors deployed to envision Internet infrastructures connote in a very much more abstract way. These metaphors draw on naturalistic iconography of organic structures (the fractal branching of trees and leaves, structured lattices of coral and webs of spiders, the fine filigrees patterning of brains or veins) and emergent aesthetics redolent of meteorology and astronomy (cloud patterns, glowing gas nebulas and star clusters).

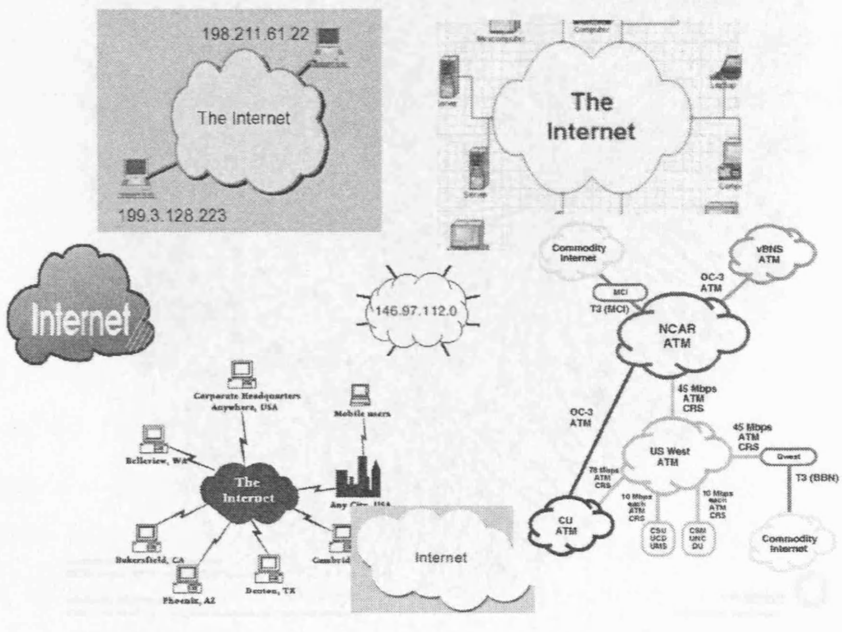


Figure 4.9: A montage of typical representations of the Internet as a cloud. (Source: various, images gathered from the Web through Google image search.)

The simplest and most common genre of abstract visual metaphors is the cloud (Figure 4.9). Curiously, cloud diagrams are ubiquitous in the Internet literature as a visual shorthand for infrastructure, particularly favoured in technical 'explanations', as they allow the author to signify the Internet as a definite object without needing to spell out the detail. As such they are a useful envisioning metaphor precisely because they obscure the infrastructure's heterogeneity and topological complexity: "the cloud's main usefulness lies in its vagueness" (Gibson, quoted in Scanlon and Wieners 1999, no pagination). Clouds can be quickly sketched and are instantly recognised, and "[a]sk the founders of the Net about the cloud, and it quickly becomes apparent that the Net cloud is as old as the Net itself" (Scanlon and Wieners 1999, no pagination).

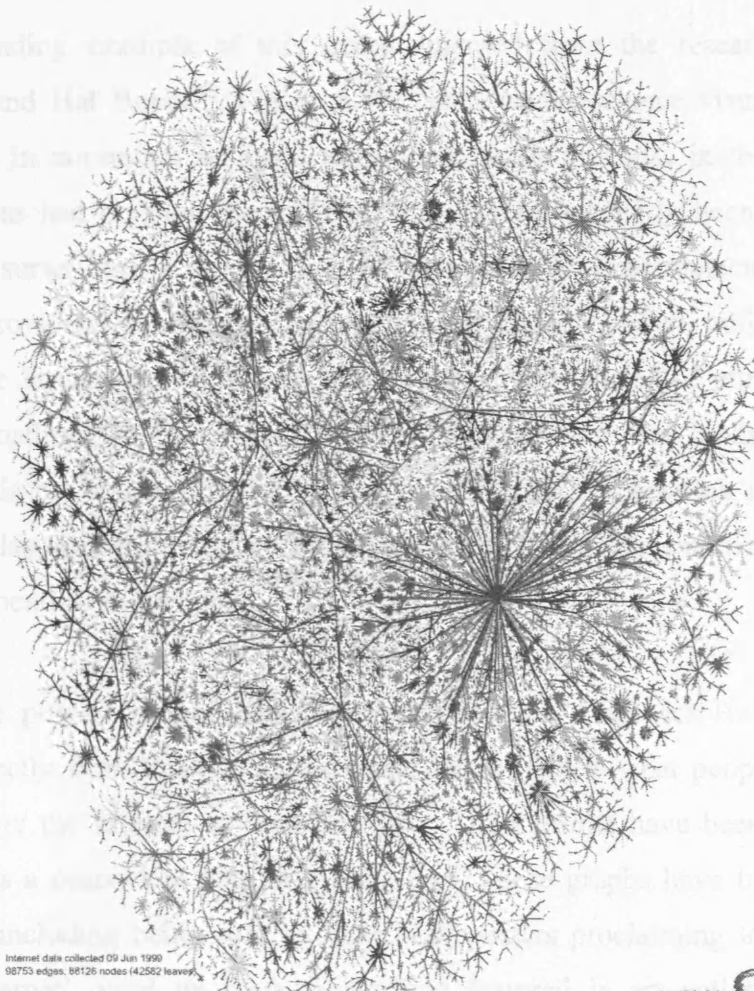


Figure 4.10: Connectivity graph to visualise the core of the Internet 'cloud' in topological terms. The colour coding of nodes is according to the IP address and seeks to highlight zones that share common network addresses and, likely, corporate ownership. The striking dark blue cluster represents a key hub owned by Cable and Wireless (formerly MCI); Cheswick describes this as "the magnetic north of the Internet". (Source: Bill Cheswick.)

Computer scientists and network researchers have produced many other abstract visual representations of the Internet that try to show the full complexity of the infrastructure rather than hide it inside cartoon clouds. These images, created by and for technoscience elites, tend to be amongst the most elaborate and visually dramatic representations of the Internet (e.g., chapter three, Figure 3.4). They use graph-like network representations to show the topology of connections and are distinct from the wiring metaphors using geographical 'arc-node' links examined above. Even though their construction is avowedly technical, some have resonated with wider public constituencies as 'artistic' renderings of the Internet.

The outstanding example of this genre emerged from the research of Bill Cheswick and Hal Burch[16] (Figure 4.10). Their technoscience visualisation is noteworthy in normative aesthetic terms, but also politically, in terms of the impact it has had on how the infrastructure has subsequently been imagined. Automatic surveying of the topology of thousands of interconnected Internet networks provides raw data that is visualised as huge, complex, multi-coloured graphs. The layout algorithm uses simple rules, with forces of attraction and repulsion jostling the nodes into a stable configuration that looks distinctly organic. It is projected within abstract space because as Cheswick notes: "We don't try to lay out the Internet according to geography ..... The Internet is its own space, independent of geography"[17].

Indeed, the power of the metaphor underlying the Cheswick-Burch graphs derives directly from this evolved, organic look - this is what people in some senses *expect* the Internet to look like now. Their results have been variously described as a peacock's wing or a coral reef. These graphs have been widely circulated, including being sold as large wall posters proclaiming to show the 'Whole Internet', used on book covers and featured in art galleries and as

[16] Begun in 1998 as a research project at Bell Labs - Lucent Technologies and subsequently continued as a part of commercial venture Lumeta, <www.lumeta.com>.

[17] Source: <www.lumeta.com/research/mapping.asp>.

exhibits in science museums[18]. Typically, these types of abstract graphs are employed as purely 'artistic' images and there are no instructions as to how they maybe interpreted, or even that careful interpretation is necessary. The image's main function is as a connotation for the sublime complexity of the Internet and as a demonstration of the technical prowess of its creator.

While they have become firmly established, showing the entity with "no beginning, no centre, no end (or all beginning, all centre, all end)" (McClellan 1994, quoted in Kress and von Leeuwen 1996, 88), the wider implication of these graph metaphors is the number of people who assume that they denote the endogenous characteristics of the Internet infrastructure itself. In fact, all the visual properties of the graphs (geometry of the lines, their spatial arrangement, colours, etc) are exogenous to the phenomena being mapped; they are in that sense purely technical artefacts. Changing the parameters of the graph layout algorithm even slightly can produce a radically different looking Internet. While it is possible to make the Internet look like something from nature, there is nothing natural about the graph's appearance.

4.4 Overcoming Internet invisibility via scientific inscription

> Instead of being a figment of one's imagination ..., it will become a 'real objective thing', the existence of which is beyond doubt. (Latour and Woolgar 1979, 241)

Using ideas from science and technologies studies (STS) concerning the construction of objective authority within technoscience working practices, particularly Steven Shapin's (1984) theory of virtual witnessing, I will now consider how infrastructure invisibility is overcome by computer scientists and network engineers who are studying the structures and dynamics of the Internet.

[18] See <www.peacockmaps.com>. I worked for Peacock Maps in 2001 and contributed to the publication of the 2001 *Whole Internet* poster. Book covers include: Castells' *Internet Galaxy* (2001); Mitchell's *ME++: The Cyborg Self and the Networked City* (2003).

According to detailed ethnomethodological studies[19] by STS scholars, the natural and biological sciences do not discover 'laws of nature', but socially construct knowledge by stabilising particular experimental findings as widely agreed 'facts'. Because the phenomena to be experimented upon are usually undetectable directly by human senses, they require measurement techniques and graphical inscriptions to make them visually apparent. There is an almost obsessive preoccupation by scientists and engineers with such inscription (Lynch and Woolgar 1990), producing a bewildering array of "traces, spots, points, histograms, recorded numbers, spectra, peaks and so on" (Latour and Woolgar 1979, 88). Indeed, Latour (1990, 42) has characterised laboratory work as fundamentally a "cascade of inscriptions". As visual re-presentations of 'nature' such scientific inscriptions are constructed from direct empirical measurement, then cleaned, redrawn, smoothed, transformed, and finally displayed prominently in publications to the bolster the of the truth claims made in the text.

The potency of such inscription is due, in large part, to the ocularcentric nature of Western scientific practices. Since the Enlightenment, vision has been the dominant mode of understanding of the material world: 'seeing is believing'. Reflecting this primacy of vision, most geographical research, for example, was, until recently, a matter of 'looking' at the landscape as the best way of obtaining truthful knowledge (Sui 2000). It has been argued that the Enlightenment 'scientific revolution' itself depended significantly on Renaissance development of new ways of seeing, such as linear perspective, which allowed the creation of far more mimetic inscriptions of reality (Edgerton 1975). Many 'technical' approaches in engineering-drawing, which are now taken-for-granted modes of inscription, were invented at this time, such as the orthographic projection depicting three views of an object, the exploded view to show how complex mechanisms were assembled, and the cut-away view to show internal workings. Contemporary scientific endeavour - partly in response to modern media driven agendas – has also realised the power of inscription for public communication and promotion; as Heller (2003, 57) wryly notes: "[s]cientific disciplines with

[19] These seek to understand scientific epistemology by looking at what scientists and technicians actually do in their everyday working practices, rather than accept the formally published methodology of 'discoveries' as sufficient explanation for the production of knowledge.

good pictures are rich in resources that keep them ... moving forward." This equally applies to those scientists seeking research funding to study the dynamics of the Internet.

Inscriptions are usually produced by measuring devices, specialised machines or an assemblage of apparatus designed purposefully to "transform pieces of matter into written documents" (Latour and Woolgar 1979, 51). Inscription devices come in all different sizes and work in a myriad of different ways - from a simple weighing balance up to an sophisticated radio telescope - but their end result is always the same - inscriptive markings written out on paper. The markings are invaluable to scientific endeavour because "scientists themselves base their own writing on the written output of the [inscription devices]" (Latour and Woolgar 1979, 51).

Yet, the real importance of inscriptions, Latour and Woolgar (1979, 245) argue, is "not so much as a method of transferring information but as a material operation of creating order." Inscriptions work to 'create order' within the social practices in technoscientific settings in several ways. Firstly, they define objects of interest. They are seen as having a direct relationship to reality, providing the focus of discussion about the properties of the phenomena that are otherwise invisible. The pattern of peaks on the graph is itself analysed as a legitimate object of scientific study. Secondly, they are a means for organising collaborative effort between scientists and reaching common agreement on 'what is happening'. As such, Roth and McGinn (1998, 217) characterise inscriptions as 'conscription devices', noting how they are of such importance in many discussions that "scientists and engineers will stop a meeting to fetch a design drawing, produce a more or less faithful facsimile on the whiteboard, or render a diagram in a gesture." Inscriptions are also a most effective means of forging unity of effort across different communities of practices, which may well be distributed geographically and in time. In this way inscriptions work publicly in the production of 'matters of fact', that is discrete elements of knowledge that have been verified by the scientific community and enjoy widespread assent as being true explanations of reality.

However, a significant problem in the production of such 'matters of fact' is the limited access to experimental activities and the inner working of inscription devices for independent verification. Scientists strive to solve this verification problem through what Shapin (1984) describes as a process of 'virtual witnessing', a way that an experiment can be validly observed via a particular kind of publication of results rather than by being physically viewed in the laboratory. Assent that an inscription constitutes valid 'matters of fact' can, thus, be manufactured remotely and infinitely using 'literary technology'. This is now easily recognisable and taken-for-granted as an 'objective' style of scientific writing, but it had to be invented[20]. It comprises a functional, dispassionate form of prose, with a puritan form of diagrammatic inscription. The results, Shapin and Schaffer (1985, 62) argue, "served to announce, as it were, that 'this was really done' and that 'it was done in the way stipulated'; [it] allayed distrust and facilitated virtual witnessing." Objectifying 'matters of fact' works by the denial of human subjectivity. 'Facts' have to appear to have been discovered from nature rather than being man-made artefacts.

For this kind of 'literary technology' to be successful in virtual witnessing it requires that scientists themselves be 'modest witnesses' - "the author as a disinterested observer and his accounts as unclouded and undistorted mirrors of nature" (Shapin 1984, 497). Modest witnesses describe facts objectively for the advancement of science, not for personal rewards; and they willingly admit weaknesses in their methods and present the results of failed experiments. "Such an author gave the signs of a man whose testimony was reliable" (Shapin 1984, 497). They produce descriptive and systematic work and do not indulge in overly theoretical and speculative writing.

Literary technology for virtual witnessing also mandates a very particular style of published inscriptions. The now conventional scientific 'look' of inscriptions is achieved through various semiotic strategies, many of which are also evident in the generation of objective authority in modernist cartography (see discussion in

[20] Shapin and Schaffer (1985) argue it came about in relation to the contested emergence of experimentalist natural philosophy in the mid seventeenth century. They highlight the significance of Robert Boyle's empirical studies on the nature of vacuum using air-pumps.

chapter two). Objective authority is, in large part, constructed by how the image-marker chooses to position the viewer in relation to the data. Typically, technical pictures are authored as the 'view from nowhere' that situates the viewer as an outside observer. Kress and van Leeuwen (1996) identify several distinct viewpoints that convey an 'objective attitude' by eliminating the subjective distortions associated with linear perspectivism. These disinterested positions include the front-on view, the cross-sectional view and, most significant, the top-down angle that "contemplates the world from a god-like point of view, puts it at your feet, rather than within reach of your hands" (Kress and van Leeuwen 1996, 149).

Besides employing such objectifying viewpoints, the scientific inscription's most conspicuous semiotic strategy is the strategic use of blank space. Scientific diagrams are most recognisable by their lack of decoration or aesthetic embellishment. Graphical austerity connotes objective authority. The data are always denoted on an bare white canvas to focus attention and to connote that the data is sufficient and stand alone for inspection; the existence of issues of uncertainty and province in the data are connotatively covered over by the blanket of white space. Such emptiness, according to Lynch (1985, 59), "is infused with moral significance, inasmuch as it involves the tacit claim of scientific integrity, with motives assumed to be beyond reproach, and is offered with an unstated presumption that, if anything significant should have been said about the operational history of the graphic line, it will have been stated." This kind of semiotic interpretation is applicable to the connotative meanings of modernist cartography, with Wright (1942, 527) noting that "[t]he trim, precise, and clean-cut appearance that a well drawn map presents lends it an air of scientific authenticity that may or may not be deserved .... We tend to assume too readily that the depiction of the arrangement of things on the earth's surface on a map is equivalent to a photograph – which, of course, is by no means the case." We can also draw direct parallels to MacEachren (1995) two internal map connotations of veracity and integrity discussed in chapter two. He gives the exemplar of official topographic mapping claiming that "[t]he U.S. Geological Survey uses highly detailed, unadorned, visually unassuming maps to connote accuracy, impartiality, authority – thereby creating an impression that the U.S. Geological Survey maps have no point of view" (MacEachren 1995, 335).

A noteworthy manifestation of the active manufacture of cartography with 'view from nowhere' in the empty space, as Turchi (2004, 37) says: "a blank on a map became a symbol of rigorous standards; the presence of absences lent authority to all on the map that was unblank." The origin of this strategy for a 'scientific' mode of cartography is often traced to Jean Baptiste Bourguignon d'Anville's 1749 map of Africa with its famously blank interior replacing earlier imaginings of map-makers. Yet, this map is not only a laying claim to honesty, for as Hiatt (2002, 248) points out, "the blank testifies to a lack of possession, since it signifies land, rather than territory, earth rather than ownership. Consequently, the blank also can be seen to invite exploration, and in a colonial context this is the inevitable prelude to acts of demarcation."

Allied to the strategy of blank space is the normalising power inherent in scientific inscriptions. They work as 'sensible pictures' according to Lynch (1985), to literally refigure the natural world into geomatisied and mathematised form. Continuous phenomena are measured into detached units of data, these are classified and transformed, then plotted into idealised, abstract graphical space that is correctly determined by its labels, axis, scales and legends. (As discussed in chapter two this kind of charge is made again official maps by those advocating critical cartographic deconstruction. Also, see chapter five in relation to the normalising effects of statistical maps). In effect, all data points on a scatter graph become exactly similar (except for their position in the grid) and "all other circumstantial features of their observation 'drop out'" (Lynch 1985, 43).

4.4.1 Virtual witnessing of Internet infrastructures

Computer network infrastructures have been constructed as objects of 'scientific' study since the very beginning. The engineers and computer scientists involved in designing ARPANET in the 1970s, for example, produced detailed analysis of its topology and performance from direct measurement of the network (e.g., Frank *et al.* 1972). Their goal was to discern the underlying 'facts' of wide-area computer communication by experimental study of the real dynamics of a working packet-switching network.

Today, a sizeable interdisciplinary 'Internet science' community undertakes experimentally-driven studies using positivist scientific approaches. The self-stated aims of 'Internet science' research are primarily pragmatic, being to aid future engineering efforts to achieve more optimal design of data routing software and equipment through more accurate descriptions of the Internet. A key part of this work involves building complex inscription devices in the form of large-scale software systems for passively monitoring traffic flows or actively scanning instruments to measure the connectivity of the network from multiple sample points (see Murray and Claffy 2001; Spring *et al.* 2004 for reviews). To achieve this, most inscriptions devices use the network infrastructure to measure itself (Dodge 2000d).

Whilst sharing much of the ethos with other scientists and engineers, 'Internet science' research centres suffer because they have little or nothing in the way of scientific equipment in their labs, so the output of the software-based inscription devices becomes all the more critical to witnessing their work. Their inscriptions strive to render the Internet 'factually', as opposed to most of the more 'impressionistic' envisioning produced through visual metaphors for lay audiences, discussed early in this chapter. A range of different inscriptions are produced, including schematic diagrams, statistical charts and tables and, most especially, complex topological graphs. Another notable feature of their inscription practices is the desire to present ever greater data volumes as a kind signifier of machismo in modern scientific endeavour.

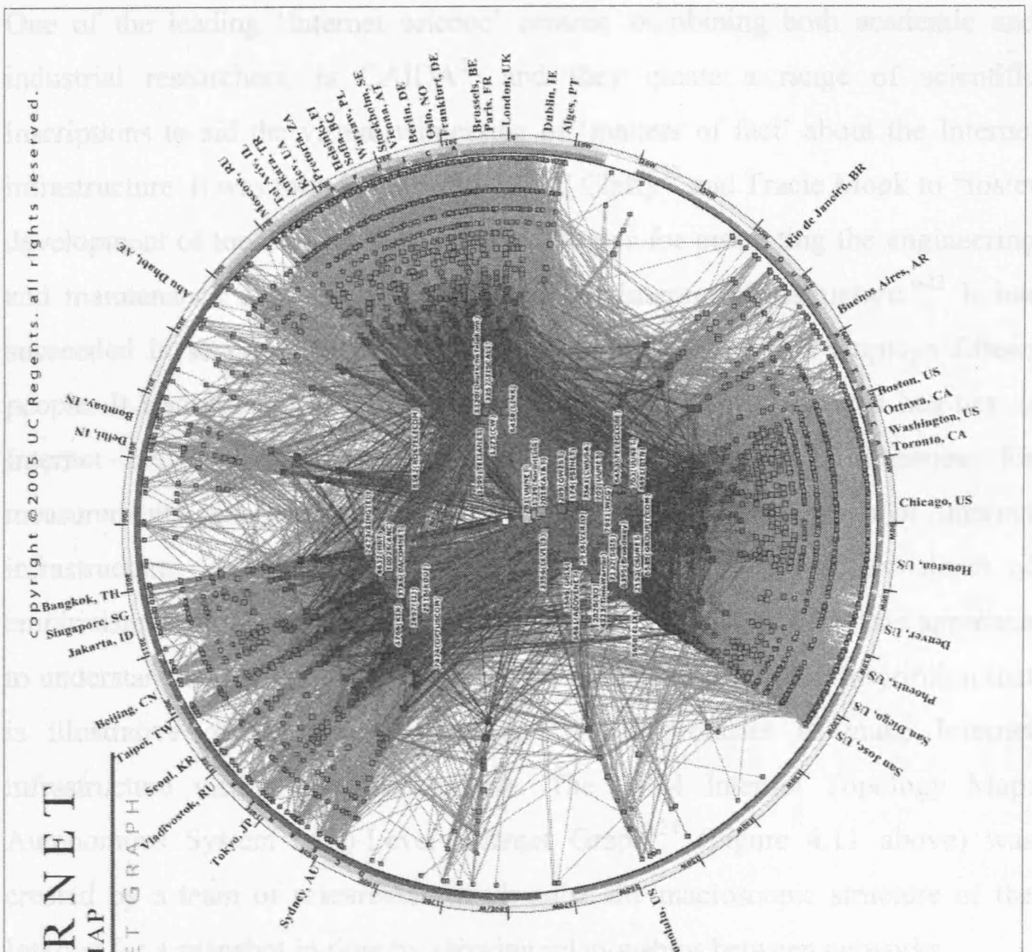


Figure 4.11: A scientific inscription of Internet connectivity measured in April 2005. It is used as a key part of the virtual witnessing of 'Internet science' researchers at CAIDA, producing a matter of fact of the otherwise unobservable infrastructure.

(Source: <www.caida.org/analysis/topology/as_core_network/>.)

One of the leading 'Internet science' centres, combining both academic and industrial researchers, is CAIDA[21] and they create a range of scientific inscriptions to aid the virtual witnessing of 'matters of fact' about the Internet infrastructure. It was founded in 1997 by KC Claffy[22] and Tracie Monk to "foster development of tools and analysis methodologies for promoting the engineering and maintenance of a robust, scalable global Internet infrastructure."[23] It has succeeded in securing multi-million dollar grant funding and employs fifteen people. It also collaborates extensively with industrial partners and has ties to Internet network operators. CAIDA exhibits a fetishistic obsession for measurement, generating huge data volumes on different aspects of Internet infrastructure performance. This is perhaps unsurprising, given the depth of empiricism underlying most engineering practice associated with this approach to understanding networking. Here I focus on one example of an inscription that is illustrative of the type work that CAIDA produces to make Internet infrastructure visible and researchable. The 'IPv4 Internet Topology Map: Autonomous System (AS)-Level Internet Graph'[24] (Figure 4.11 above) was created by a team of researchers to visualise the macroscopic structure of the Internet for a snapshot in time by showing relationships between networks

An important element in the inscription is the large-scale, automatic measurements of the Internet's topology, using a distributed systems of scanning beacons, known as 'skitter'. This generates large data volumes which are aggregated and filtered prior to visualisation. So the 220,000 odd individual nodes in the skitter dataset were aggregated by the ISP that they belonged to, based on the technical grouping by Autonomous System (AS) number. This yielded some 1516 AS nodes which represent the most highly connected ISPs

[21] The Co-operative Association for Internet Data Analysis is based at the San Diego Supercomputing Center, the University of California at San Diego, <www.caida.org>.

[22] Her 1994 PhD thesis topic, in some senses sets the tone of CAIDA's research, entitled: "Internet traffic characterization: a methodology to support more accurate workload characterization in the face of increasing diversity in Internet traffic types and qualities."

[23] Source : <www.caida.org/home/staff/kc/kclaffy.xml>.

[24] Source: <www.caida.org/analysis/topology/as_core_network/>. Research team: Brad Huffaker, Andre Broido, KC Claffy, Marina Fomenkov, Sean McCreary, David Moore and Oliver Jakubiec.

that form the core of the Internet and carry the bulk of the traffic. These are plotted as dots in a calibrated space as 'matters of fact' on the topology of the Internet.

Its form is a complex graph displayed using a polar projection, where each AS node encodes two data characteristics. First, the distance away from the centre shows the relative strength of peering relationships with other networks. Second, the angular position around the circumference of the circle shows the approximate geographical position of its corporate headquarters[25]. The peering links between ISPs are shown by the arcs which are colour-coded 'hot to cold' based on the relative strength of connection (as indicated in the legend). So yellow, central nodes are some of the most well connected ISP and the scientifically witnessed core of the Internet.

In terms of the geographical data encoded in the inscription, one can think of this as somewhat like a map of the Earth, with a projection centred on the North Pole. Around the circumference of the graph, longitudes are marked every 10 degrees and coloured strips denote different continents. Key cities are also labelled. The graph generally divides the nodes into three distinct segments based on the continents of North America, Europe and Asia/Oceania related unsurprisingly, to the major metropolitan nodes in the world economy.

In normative terms, the IPv4 Internet Topology Map has the ability to identify the most powerful ISPs and where on the globe are they are concentrated. It is clear that the densest concentration of AS nodes, towards the centre of the graph, lies along the longitude of about 70 degrees west, which relates to the eastern seaboard of the USA. The headquarters of some of the leading Internet backbone operators such as UUnet, PSInet, Qwest, CWUSA are found there. In many ways this inscription reinforces what is apparent from many of the other infrastructure maps of the global Internet – that the U.S. is the dominant player in terms of infrastructure provision. It has been described as the world's 'switching centre'

[25] Obviously there is considerable generalisation as many large ISPs will have their infrastructure spread across the globe. As such, one might like to think of this as more of a geopolitical location.

(Singel 2007) in terms of global traffic flows. In fact the top 15 most connected AS nodes are in North America (one is in Canada). The IPv4 Internet Topology Map also reveals that many of the ISPs based in Europe and Asia-Oceania have relatively much fewer connections between them, relying instead on peering with U.S. backbones to act as a hub.

Besides the normative reading, this graph clearly is a significant scientific inscription for CAIDA. It enjoys prominence in many of their presentations[26] and is displayed in pride of place on their Web homepage. Whilst there have been some attempts to use it metaphorically as an impressionistic visualisation (for example it is available for purchase on wall posters), it is too technical, and it lacks the immediate visual punch and instant recognition of a more familiar metaphor (for an example of a global image, see Figure 4.4; for world maps, see chapter six). It makes use of all three semiotic strategies to achieve the dispassionate 'scientific look' needed for a successful inscription to use in virtual witnessing processes. Firstly, it situates the viewer in a top-down position, inspecting the data from a God's-eye vantage point, apparently offering totalising vision 'over' the core of the Internet. Secondly, the graph itself is embedded in a antiseptic, blank canvass, unadorned except for title and technical scale bar. Lastly, the graph is an archetypal 'sensible picture' with the connectivity of the Internet thoroughly re-figured to fit into calibrated, circular space. The reality of the Internet is reduced to an orderly (albeit informationally over-crowded and in some area illegible) layout of dots in a graph.

More generally, the way that IPv4 Internet Topology Map is embedded in the web page text[27] also demonstrates how this inscription functions as part of CAIDA's virtual witnessing of the Internet's topology. Firstly, the witnessing makes claims to sources of empirical data that are comprehensive and accurate. The size of dataset is given precisely, along with exact dates when the experimental measurements were run. The description of the data uses various

[26]<www.caida.org/publications/presentations/>

[27] Source: www.caida.org/analysis/topology/as_core_network/>.

specialised terms that create an aura technocratic authenticity. The witnessing also uses other strategies to bolster its objective attitude, such as:

(1) making older versions of the graph available for consultation,
(2) making the raw data available for independent verification,
(3) setting out a detailed list of caveats demonstrating that the authors are 'modest witnesses' willing to admit their weaknesses,
(4) text sets out the 'insights' in terms of descriptive, experimentalist understanding of Internet topology only and makes no grand theoretical claims - again this is a necessary tactic of the 'modest witness'.

4.5 Conclusions

Ultimately, the choice of how to visually represent the Internet, to overcome infrastructure invisibility, is a far from simple question. Over time many conceptions have dominated. Implicit in any approach are the underlying power geometries of the metaphors used (verbal, visual, numerical) regarding what the Internet is, and more importantly, what it could be. None of these conceptions can really be said to be 'incorrect'. The various impressionistic visualisation and technical diagrams can be seen as imaginal explorations of what the Internet is 'at its essence'. In some respects, this exploration phase has ended, various metaphors and diagrams having been tried and rejected, while a few dominant ones have been legitimated[28]. Certain kinds of cartographic representation remain one of the mainstays for overcoming Internet invisibility. Two of the most firmly established genres of mapping that are in common use, and are clearly deemed to be effective to some degree for this process, are route maps showing network structure and thematic maps showing aggregate national statistics. How these two genres of mapping work semiotically and politically to make the Internet visible and tangible, in particular ways, is the focus of analysis in the next two chapters.

[28] Indeed, as Internet as become commonplace, it has itself become a metaphor in its own right, for example, used to describe new forms of decentralised, corporate organisation or supposedly new modes of war fighting.

In conclusion, spatial metaphors and scientific inscriptions not only make visible the invisible infrastructures of the Internet, they work as narrative devices to dramatise the dull and banal nature of a network wholly lacking in striking physical motifs of soaring airliner or impressive architectural displays. Thus they explain visually what the Internet looks like, but they also delude in equal measure, as this is never a view of the Internet one could see naturally. This applies, for example, to the kinds route map discussed in chapter six which are created by commercial operators to market their network and use various design strategies to try to demonstrate they have the best available infrastructure. Although from empirical evidence, investigated in chapter six, they have varying degrees of success at connoting wholly positive impressions because they often represent their infrastructure too realistically rather than more metaphorically.

Chapter Five

Statistical Mapping of Internet Globalisation

Jobs, knowledge use and economic growth will gravitate to those societies that are the most connected, with the most networks and the broadest amount of bandwidth.

-- Thomas L. Friedman, *The Lexus and the Olive Tree*, 1999.

Almost the whole world, it seems from a casual inspection of this map, has turned Internet-coloured. The sun never sets on the Internet; it appears to reach everywhere except some war-torn corners of the world.

-- Mike Holderness, *Who are the World's Information Poor?*, 1998.

5.1 Introduction

In this chapter I consider maps that provide a synoptic picture of the evolving geographical structure of the Internet at the global scale using various kinds of area-based statistical map designs. The analysis focuses, in part, on the recent history of the Internet in the 1990s as the period of mainstream 'take-off' of the Internet in most developed nations and subsequent widespread diffusion of network connectivity across the world. I consider the ways these differently designed maps serve politically to produce particular imaginative geography of the Internet, either masking or exposing the extent of 'digital divides' across the world. These maps are valuable as they highlight the multiple ways that a statistical understanding of social phenomena can be represented, particularly when seen in contrasting cartographic designs deployed (choropleth, cartogram, dasymetric, stepped surface and diagram mapping techniques).

The chapter begins with an outline discussion of the discourses of development and digital divides that underpin the use of statistical maps of Internet globalisation, and then sets out a fourfold conceptual model of connotative meanings based dimensions of difference and complexity that is used to inform the empirical analysis. This is followed by a brief contextual history of the emergence of statistical mapping as a politically powerful representation before moving onto an interpretation of a range of empirical material.

5.2 Connecting the world: Tales of Internet diffusion and digital divides

The Internet grew tremendously during the 1990s. One of the most impressive elements in this growth was the speed by which countries across the world became connected (Figure 5.1). The first half of the 1990s, in particular, can be conceptualised as the 'globalisation' of the Internet, starting from a U.S core, spreading throughout the reminder of the developed world and then linking to poorer, peripheral nations, so that by the end of decade most countries had at least some form of connection to Internet. The rapid globalisation of the Internet was facilitated by a number of technological developments, as well as wider political and economic factors which benefited new forms of low-cost international computer networking.

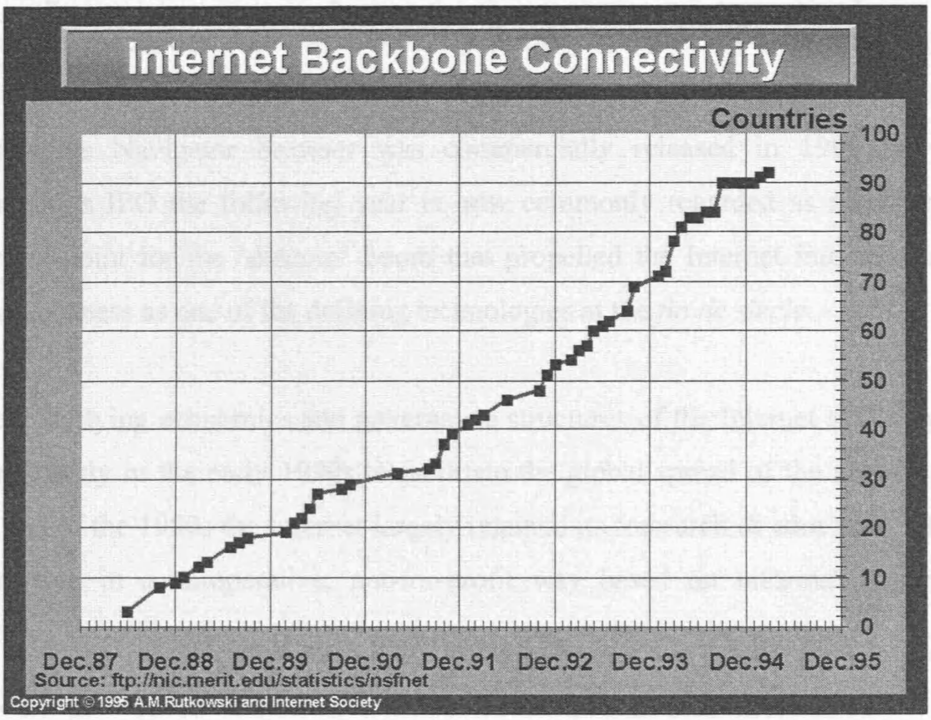


Figure 5.1: A typical growth chart demonstrating the rapid pace of Internet expansion from the late 1980s through the first half of the 1990s as measured by the number of countries connected. The de facto meaning of 'Internet backbone connectivity' during this period was a direct link to the U.S. to reach the National Science Foundation network. (Source: Rutkowski 1995.)

The most significant technological factor was developments in long-haul fibre-optic transmission systems, particularly undersea cables linking continents, made in the 1980s. This led to an order of magnitude growth in available bandwidth[1] and concomitant decline in circuit costs in the 1990s. (See also chapter six for more discussion of the boom in fibre-optic infrastructures in relation to network marketing maps.) The majority of investment in new undersea cable systems, however, was on a select few routes linking together already well-connected industrialised regions and major cities (Graham 1999), beneficially reinforcing existing transportation routes (Arnum and Conti 1998)[2].

Demand for this new bandwidth was driven by exponential growth in Internet traffic in the early 1990s resulting from many new users, new interfaces to navigate online information spaces and wholly new applications (see analysis by Coffman and Odlyzko 2000). Web traffic growth in the early 1990s exploded, growing at several thousand percent per year and quickly outstripping all other Internet applications (Odlyzko 2000). By helping to make it a mass medium, the Web was also a critical element in the commercialisation of the Internet. Netscape's Navigator browser was commercially released in 1994 and the company's IPO the following year is now commonly regarded as marking the starting point for the 'dotcom' boom that propelled the Internet into the public consciousness as one of the defining technologies at the *fin de siecle*.

The underlying economics and governance structures of the Internet also evolved significantly in the early 1990s to facilitate the global spread of the network. At the end of the 1980s the Internet largely retained its 'research & education' ethos, being run in a co-operative, not-for-profit way based on informal consensus

[1] This growth was reified by technology commentator George Gilder in his 'law of telecosm', which states: "The world's total supply of bandwidth will double roughly every four months - or more than four times faster than the rate of advances in computer horsepower [Moore's law]." (Rivlin 2002, no pagination). See also 'Metcalfe's law' on connectivity states that the value of a telecommunications network is proportional to the square of the number of users on the network (cf. Odlyzko and Tilly 2005 for discussion of the validity of such 'laws of networking').

[2] The current geographical pattern of submarine cables is mapped in Figure 4.1, chapter four.

reached by a small cabal of 'techies'. It was dominated by the quasi-academic[3] U.S. National Science Foundation Network (NSFNET), which was the largest and fastest network and thus formed the effective central 'backbone' of the Internet during the late 1980s and early 1990s. The 1990s saw the transition of the Internet core in the U.S. from a public to a fully privately managed and financed infrastructure. In 1991 commercial traffic was allowed and soon the major proprietary online services - including AOL, CompuServe and Delphi - provided gateways to the Internet to allow exchange of email. An increasing number of commercial ISPs emerged, creating an affordable dial-up Internet access market for domestic users in several developed countries. In 1995 the Internet backbone itself was 'privatised', as NSFNET was decommissioned. One noteworthy symptom of commercialisation and changing management of the Internet was a transformation in online culture, to the chagrin of many long-time users[4].

Beyond the network, so to speak, the world-wide spread of the Internet was facilitated by significant broader geopolitical changes at the start of the 1990s, announced by the fall of the Berlin Wall and the collapse of the Soviet Union. Many states, particularly in Eastern Europe, became more open to external trade, economic investment and media flows, often accompanied by marketisation of industries. The liberalisation of telecommunications monopolies in many developed countries also opened up 'market space' for new businesses to start providing commercial Internet access services. In complex ways, then, the spread of the Internet was greatly *aided* by the wider globalisation 'project' that many see as characterising the 1990s (Dicken 2003). Yet at the same time the Internet was itself playing a key part *enabling* this economic and political globalisation - for example, by easing data flows, flattening hierarchies of communication and,

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[3] It was government-funded but run by private corporations under an agreement with the National Science Foundation. It had an operational charter forbidding transmission of commercial traffic for the first five years of its operation.

[4] Feelings about this time are nicely summarised by Guédon's (2002, no pagination) reminiscence: "I remember the dismay of old-time users like myself when the AOL crowd showed up, with no manners, no understanding of the community spirit that had developed quietly in the 80s, no comprehension of the sharing and give-and-take quasi-utopia that had grown somewhat confidentially in their midst."

above all, lowering transaction costs (Cairncross 1997).

Unsurprisingly, interpreting the nature of the Internet's global growth has been the subject of intense and competing analysis through the 1990s, focused in particular on the implications for economic and social development likely to flow from connectivity (cf. Castells 2001; Drori and Jang 2003; Main 2001; Shade 2003; Warf 2001). In binary terms, the debate around the meaning of Internet globalisation can be conflated into two viewpoints: what I label here 'diffusion' and 'division' perspectives[5]. The first discourse sees the world as a relatively orderly matrix of countries, which are broadly *converging* as ICTs, having a beneficial impact (bringing about enhanced knowledge and greater opportunity). In contrast the alternate 'divistionist' perspective conceptualises the world as a more fragmented set of places and social groups, with disorderly processes of change (not solely growth) resulting increasing *divergence* as ICTs have impacts that are often detrimental (bringing about more unequal access and greater scope for exploitation).

The broad 'diffusionist' coalition of scholars, activists, technology commentators and network builders who view the Internet as essentially a progressive tool for social empowerment and development. For example, the then U.S. Vice President, Al Gore (1994) in a utopian call to create a global information infrastructure, asserted: "I see an new Athenian Age of democracy forged in the fora the GII [Global Information Infrastructure] will create." (See chapter four for further discussion of Gore's role in promoting the 'information superhighway'.) Network connectivity in the 1990s was seen as a potent tool to diminish of economic difference between regions of the world. The rapid diffusion of access, particularly of personal email communication, would connect people in the less developed regions directly into the core, and the mutual flows of information, ideas and knowledge engendered would be beneficial to all, fundamentally overturning power differentials. Ultimately development, driven through Internet

[5] Obviously, this characterisation is a simplification for purposes of the current discussion, but it resonates with many other debates about the 'impact' of ICTs which tend to split along broadly utopian or dystopian lines (cf. Graham 1998).

access and ICTs, brings about social and economic convergence at different scales.

The alternative, 'divisionist' discourses, focused on the hegemonic power of technologies, are deeply sceptical of the progressive potential of networking and typically viewed the Internet as simply adding another layer of inequality between nations (cf. Jordan 1999; Main 2001). Far from being economically empowering, the Internet and ICTs are active in *widening* divisions, enabling the developed regions to exploit the less developed more effectively. In the future, the Internet promises, so the argument goes, "the distinction between developed and non-developed countries will be joined by distinctions between fast countries and slow countries, networked nations and isolated ones" (Baranshamaje *et al.* 1995, quoted in Holderness 1998, 37). The winners of world-wide Internet growth - much like other dimensions of globalisation in the 1990s - would be those select few switching points able to direct the flows and extract surplus value. Besides economics, the potential of Internet to level social differentials in power was also questioned: "Despite the assertions of the people at Wired[6] and other end-of-politics theorists, class stratification and oppression have not been eliminated by computers or any other technology" (Surman 1995, no pagination). In this way development that is delivered through infrastructural intervention, such as building Internet access and giving ICT equipment actually brings about social and economic divergence at different scales.

Fundamentally then, the 'diffusionists' and 'divisionists' positions disagree on the extent to which the Internet as agent of social and economic development can make the world a 'better' place. Assessment of the undoubted unevenness of Internet penetration is a key element for both sides, with concerns being most publicly articulated in 'digital divides' discourses. The digital divide emerged as a distinct 'problem' for academic analysis and political action in the late-1990s with major international summits held and the formation of high-profile taskforces to measure the scale of inequality and develop acceptable policy solution (such as

[6] This alluded to the utopian rhetoric espoused by writers in Wired magazine, which was in the 1990s an influential voice in Internet discourses in the U.S. (Jordan 1999).

the G8 Dot.Force[7]). At the global scale, the African continent is often highlighted as needing special attention; for example, a *New York Times* article from this period stated: "From the White House and the World Bank to international business and academic circles, analysts warn that unless Africa gets online quickly, what is already the poorest continent risks greater marginalization" (French 1995, 5). For the advocates of the 'diffusionist' position, the evidence of digital divides was useful for highlighting where extra effort was needed and, anyway, these differentials in access were just a temporary 'blip' that could be relatively quickly ironed out (usually through delivery of better infrastructure to the most disconnected places). The same kind of evidence was used in a more incriminating fashion in 'divisionist' discourses to puncture the utopian hype of the 'diffusionists' and point up the absurdities of the 'global information society' rhetoric when large parts of the world still lack basic infrastructure, including reliable electrical supply to power computers.

Both sides seek to create particular imaginary geographies of the worldwide spread of the Internet to suit their agendas, deploying potent metaphors and tables of statistical data, along with specific case studies of successes in 'wiring' up places or personal stories of continued exclusion from the information age. In terms of spatial metaphors deployed, the most prevalent ones seen in the mid-1990s drew a direct analogy between computer networks and road networks, with the 'diffusionists' proclaiming the Internet as the coming 'information super highway'. This was pointedly countered by the 'divisionists' camp who said it was clear that most of the world would be left to struggle along 'digital dirt tracks' (see discussion in chapter four). Certain kinds of representations of the nature of Internet globalisation are also prevalent and rhetorically significant in the competing truth claims of these discourses, as actors seek to garner support to their point of view through the authority incumbent in certain types of images, particularly the scientific legitimacy connoted by statistical charts and thematic maps. Many official reports, activist documents and scholarly articles tactically

[7] The Digital Opportunities Task force was instigated by the G8 heads of state at a meeting in Okinawa, Japan in July 2000, <www.markle.org/dotforce.html>. It has been criticised for its 'top-down' model of development driven by technology which favours the interests of corporate capital above the needs of citizens (Shade 2003).

deploy bar charts and scattergrams demonstrating obvious statistical trends to aid their case by making complex sets of social phenomena into visible and unified objects of analysis. As Buck-Morss (1994, 440) says in her work on how graphic representations helped to make the 'economy' into an object of analysis early in the twentieth century: "the map shifts the point of view so that viewers can see the whole as if from the outside, in a way that allows them, from a specific position inside, to find their bearings." The potency of scientific looking charts is evident, for example, in latest ITU-published 'information society' report (WISR 2007), a lengthy and well produced policy document, has 40 different statistical charts and diagrams in its 147 pages to assist in picturing what actually constitutes the 'information society' as if viewed from an outside 'objective' position but clearly created from a position inside the discourse.

Given the worldwide scope and inherently geographical nature of the patterns to Internet globalisation it is not surprising the valuable role world maps play in these discourses, as different kinds of statistical mapping are deployed to show the extent to which countries are diverging or converging. The map serves to make the abstract statistical measurement into a visual pattern that is tangible and perhaps more real and *believable* than a large table of numbers or scatter chart of indistinguishable dots. The map can show the statistics in relation to powerful geographical template of continents and the mosaic of nations that is thoroughly engrained into people as the proper mental model of the world.

To make sense of the range of statistical mapping deployed by different institutions to represent the processes of Internet globalisation, a categorisation was developed based on two 'worldviews', conceptualised as two linear dimensions of 'difference' and 'complexity'. The 'difference' dimension is the extent of areal uniformity evident (at both the global and continental scale) and varies by the how the statistical patterns are denoted in the map, which in turn create connotative meanings for readers along a spectrum from universal homogeneity to abrupt and widespread inequalities between nations. The 'complexity' dimension is the degree of entropy evident (at various scales from local to global) which depends on how statistical patterns are denoted in the map by the cartographer and how the explicit representation are interpreted connotatively by readers along a spectrum from simplicity and harmony to wholly discordant and unmanageable variance between national performance. Using a pair of axes, these two dimensions of 'difference' and 'complexity' create four separate quadrants or categories of mapping semiotics (Figure 5.2). Each quadrant represents one kind of map worldview, definable approximately by the strength of its difference and complexity characteristics. The positioning of a map into a particular quadrant depends on the connotative meanings, which in turn depend, in part, on the overt graphic design choices and cartographic symbology employed, as well as the epistemological element in the data classification and normalisation and the units of measurement. Also, less obviously connotations vary depending on the underlying ontological schema of what aspect of Internet globalisation is deemed to be measurable and worthy of representation.

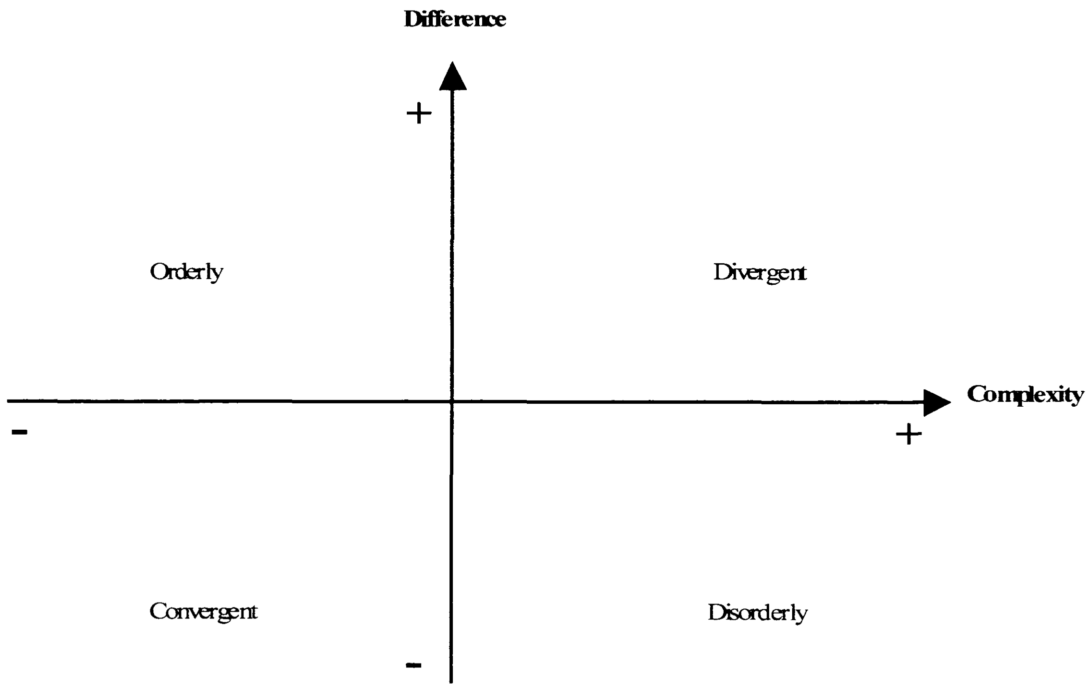


Figure 5.2: A fourfold grid of connotative meanings to categorise maps of Internet globalisation.

The four quadrants of map worldviews are defined as follows:

- **Orderly:** Maps which fall into this category are typified by the visual arrangement of data in a conceptually simple, systematic and logical fashion. The overall design aims to be a 'neat and tidy' display of the data to suggest a world in harmony. Even though nations are likely to be differentiated from each other they are presented in strongly regularised array, ranking or hierarchy that designates a clear order from worse to best. An orderly denotative form also has particular connotations about the underlying organisation of the world in terms of obedience to hierarchy (i.e., 'respectful to those who are better'), accepting the 'natural' order and the inevitability of continual difference in the world. Thus for many a statistical world mapped in an *orderly* manner implies a positive view of the world that is secure and not likely to change radically.

- **Divergent:** This group of maps is characterised by denotation of large differences between nations along with high complexity in the display of variation often at manifold scales. This is a statistical map without a harmonious pattern, exhibiting disunity with many places that deviate from the norm in an unpredictable way. There will be obvious and wide inequalities between the top and bottom classes, perhaps incomplete coverage, with stark contrasts geographically between abundance and barrenness. The connotations that may be drawn from a divergent map are of a fractured, and fracturing, world without equity and widening injustice. Thus for many a statistical world mapped in an *divergent* manner implies a negative view of the world that is insecure, unstable and getting worse.

- **Disorderly:** Typified by a highly fragmented pattern, yet accompanied with low degree of difference between nations. It is denoted by a muddled and confused display of data which implies a lack of systematic processes at work. Such visual disorganisation connotes a lack of understanding and perhaps control over changes, with wild areas that defy conventions on what should be done. It is a world without a master narrative and with deep disagreement as to the correct solution, and even whether there is a universal solution for uneven geographical development. Thus for many a statistical world mapped in an *disorderly* manner implies a negative view of the world that is ungovernable and resistant to process of economic and cultural globalisation.

- **Convergent:** The attributes of a convergent map are denoted by a simple and self-evident pattern of low inequities between nations. There are few, if any sharp divisions between neighbouring countries and the variation across the world is gradual and within manageable proportions. It is a map that shows countries are much more alike than they are different, and where relative uniformity of development is the norm and within reach for all people. The connotative implications arising from convergent maps are the that countries of the world are coming together, with a unity of purpose. It is implies common causes for the patterns and that universal solutions can be rolled out across a largely 'flat' world. Thus for many a statistical world mapped in an *convergent* manner implies a positive view of the world that is becoming more similar as countries assimilate upwards in terms of social and economic development.

The effectiveness of the maps as authoritative evidence in particular discourses, one could argue, depends on the extremity of their positioning in the opposite quadrants. For 'diffusionists' the more deeply located in convergent quadrant the better, with its stress on minimal difference between nations and low complexity imply a coherent world. For those advancing 'divisionists' agenda then an ideal map will be positioned in the top-right quadrant because it most advantageously connotes complexity and difference, a world of separate nations moving apart.

5.3 The emergence of statistical mapping

Robinson (1982, 16) defines the thematic map essentially as one that "focuses on the differences from place to place of one class of feature, that class being the subject or 'theme' of the map". The communicative goal of thematic maps is to make apparent to the reader the *spatial* distribution or structure of the theme itself and the underlying geographical base map is the backcloth to support this. The spatial description of data revealed by the thematic map can be a useful aid in determining underlying causal processes and then demonstrating the plausibility of an explanation to others (e.g., spatial diffusion patterns in epidemiological studies). An almost infinite range of possible themes can be mapped, using a wide range of representational techniques (cf. Dent 1995; Slocum *et al.* 2005). Thematic maps displaying statistical data commonly use choropleth techniques which shade areal units of enumeration to represent classified interval data, although several other approaches, such as isopleth and proportional symbol maps, are also widely deployed.

Thematic maps are one of the most widely-seen forms of cartography, being deployed in all manner of discourses and distributed in all media, the ubiquitous weather map being the most obvious. Yet, attempts at understanding the nature of the human world in terms of the nomothetic mapping of environmental, social and economic phenomena came quite late in the history of cartography. Until the late seventeenth century, cartography had focused solely on representing idiographic knowledge, with maps used predominantly as a topographic reference recording the location of unique features in the landscape, for delineating property boundaries and as tools for navigation. The development of a distinctive new mode of cartographic representation - the thematic map - focused on the *generalised* description of a single aspect of place or human activity came to the fore in the beginning of the eighteenth century and became firmly established as an outcome of dramatic changes of the Enlightenment era and later industrialised modernity (Robinson 1982).

It is now widely acknowledged that the Enlightenment and the shift into a modern society gave rise to more systematic means of managing and governing populations. People became increasingly viewed as components in larger systems: as labour commodities, as problems to be solved (e.g., ill-health, illiteracy), and as citizens. The development of 'population thinking' by centralised State institutions depended, crucially, on generating both a depth and a breadth of new statistical knowledge about society as a whole. This period saw the creation of systems of universal civil registration, standardised observational methods in morbidity, the enactment of large-scale social surveys (on education, poverty and other aspects of 'moral' status) and, ultimately, the total enumeration of the population through censuses. The concern was to gain a uniform understanding of the human resources available to the State and also to create "unitary national identities via the production of statistical measures that levelled differences, and suppressed local and ethnic identities" (Higgs 2004, 20).

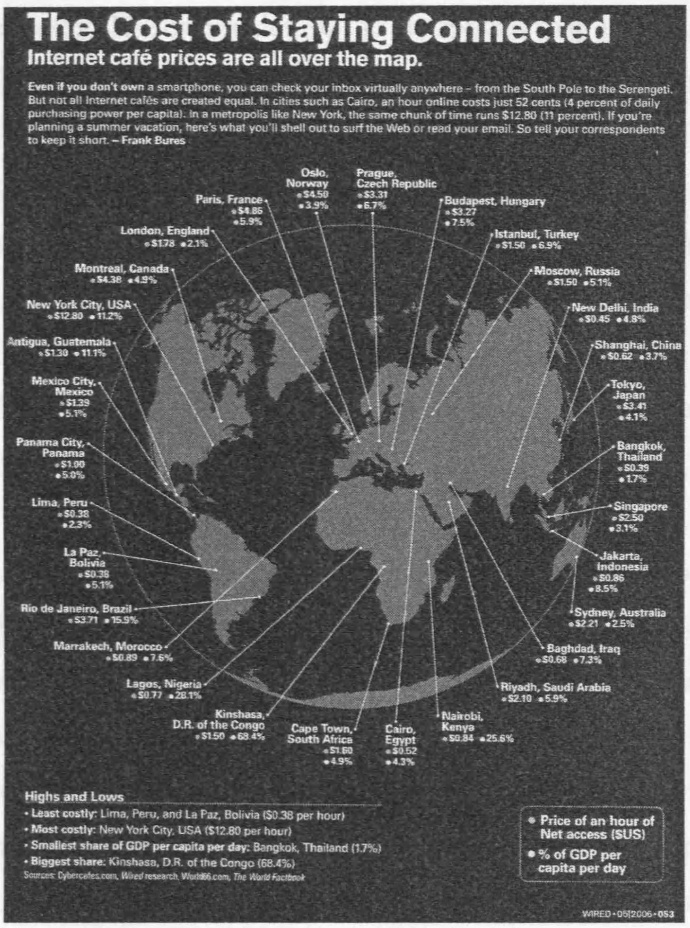
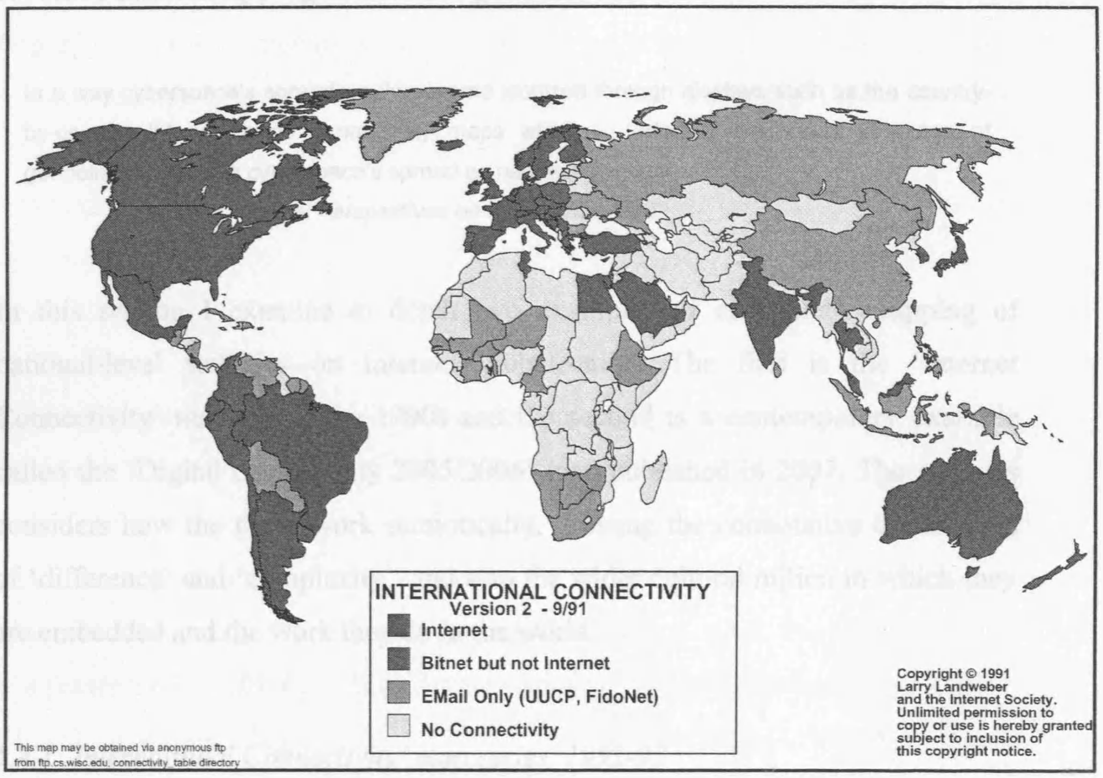


Figure 5.3: A literal mapping of Internet statistics onto place. The actual design of the data presentation means it is hard to make comparisons on how costs of Internet access varies between cities; this failing is tacitly acknowledged by the need to include the 'highs and lows' bullet point list in addition to the map. (Source: Bures 2006, 53. A larger version is reproduced in appendix two, Figure A2.1.)

This wholesale 'quantification' of society required new kinds of representation to make sense of wholly new classes of economic and demographic data being generated. Indeed, Cosgrove (2003, 133) argues that "statistics had their greatest social impact through graphic expression - graphs, charts and maps". A range of thematic maps, along with many other chart types, such as Playfair's pie charts, were invented at the start of the nineteenth century in a burst of graphic creativity (cf. Friendly and Denis 2003). William Smith produced his geological map of England and Wales in 1815 and two years later the pioneering geographer Alexander von Humboldt produced the first known isoline map showing temperature patterns. The origination of the choropleth map itself has been traced back to 1823 and work of the political economist, Charles Dupin, who was concerned with mapping the demographic capacity of the French nation (Robinson 1982, 156-57). In representational terms, choropleth maps were a significant advance in visually communicating complex socio-spatial patterns, as they replaced the accepted practice of simply writing numeric values onto the map (see Figure 5.3 above for a contemporary example) which aided the interpretation of raw data in order to discover and explain otherwise hidden spatial patterns, relations and trends.

The emergence of thematic mapping also had political implications (Crampton 2004). Statistical maps, particular of classified data, in their visual form and application tend to dehumanise the spaces they purport to represent. They are intimately involved in the production of a particular kind of governmentality, in which their instrumental rationality aggregates unique places and generalises individual human experience into easily mappable averages, rates and scores. The orderly representation of statistical knowledges offered by thematic maps are powerful, I would argue, not because of what they show, but because they can mask so well the complex, contingent social reality. The social worlds viewed through statistical mapping are thus de-socialised and rendered more easily governed by powerful institutions, as the human effects of policy decisions remain safely opaque, hidden behind the neat tables of numbers and uniformly shaded enumeration areas. (This line of argument is a key element in critical cartography paradigm on the power of maps to do work in the world; see chapter two.)



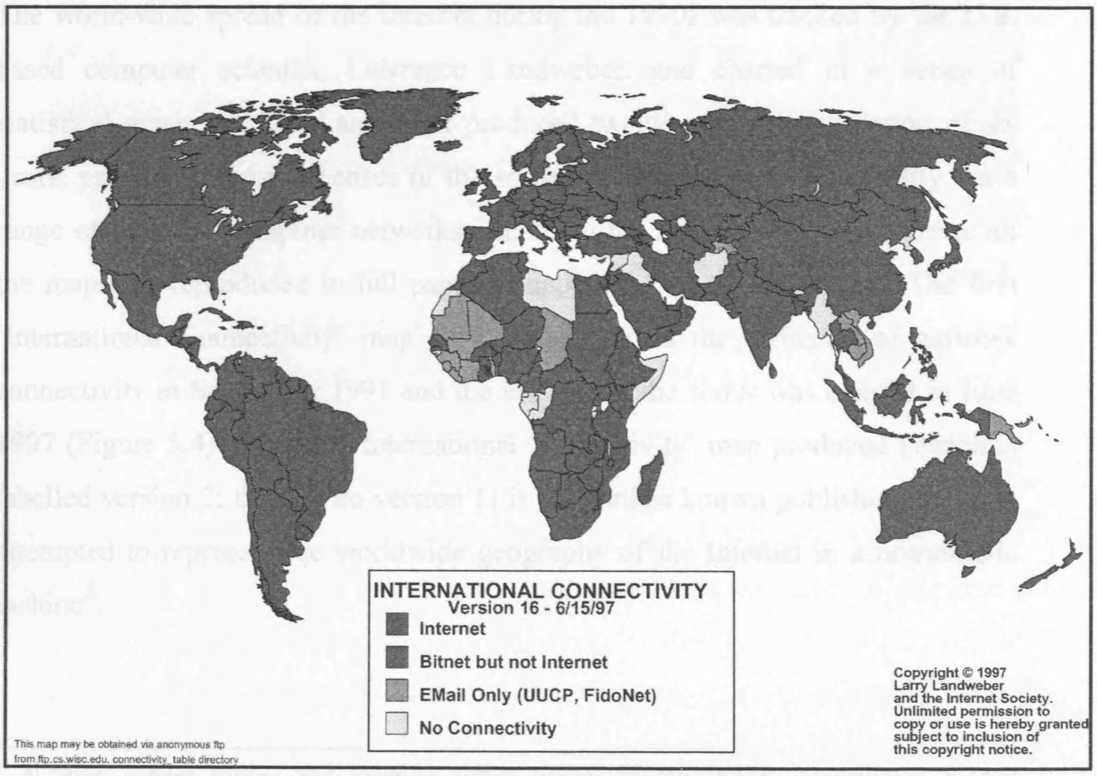


Figure 5.4: The first and last maps in the 'International Connectivity' series charting national-level Internet access. (Source: <ftp://ftp.cs.wisc.edu/connectivity_table>.)

5.4 Area-based mapping of Internet globalisation

> In a way cyberspace's spread would become iconized through displays such as the country-by-country Internet world connectivity maps which ... adopted the visual language of geopolitics in framing cyberspace's spread as national question.
>
> -- Greg Elmer, *Critical Perspectives on the Internet*, 2002.

In this section I examine in depth two examples of choropleth mapping of national-level statistics on Internet globalisation. The first is the 'Internet Connectivity' maps from the 1990s and the second is a contemporary example called the 'Digital Opportunity 2005/2006' map published in 2007. The analysis considers how the maps work semiotically, utilising the connotative dimensions of 'difference' and 'complexity', and also the wider cultural milieu in which they are embedded and the work they do in the world.

5.4.1 'International Connectivity' map series, 1991-97

The world-wide spread of the Internet during the 1990s was tracked by the U.S. based computer scientist, Lawrence Landweber, and charted in a series of statistical maps. In total, Landweber produced twelve maps over a period of six years, providing a visual census of the spread of international connectivity via a range of different computer networks, including the Internet (for convenience all the maps are reproduced in full pages in appendix two, figures A2.2). The first 'International Connectivity' map produced displayed the diffusion of network connectivity in September 1991 and the last one in the series was created in June 1997 (Figure 5.4). The first 'International Connectivity' map produced (which is labelled version 2; there is no version 1) is the earliest known published map that attempted to represent the worldwide geography of the Internet in a nomothetic fashion[8].

[8] A quite similar survey and mapping effort known as the 'FAQ: International E-Mail Accessibility Survey' was undertaken by Olivier MJ Crepin-Leblond (<www.nsrc.org/codes/bymap/ntlgy/>), but began in November 1993 and ran through eight updates until May 1997. For reference, examples of Crepin-Leblond's maps are given in appendix two, Figure 2.3, however his project is not examined here because it does not add substantively to the arguments made regarding the 'International Connectivity' maps.

By making a simple visual comparison of 'International Connectivity' maps through time, it becomes clear that a large swathe of the world's nations *appeared* to have become connected to the Internet in the first half of the 1990s. As such, these maps, and the associated data tables (see Figure 5.6 below), became established one of the most accessible and well-used sources of longitudinal data on Internet globalisation during a crucial period of growth in the middle of the 1990s.

5.4.1.1 Design of the 'International Connectivity' maps

In terms of design semiotics, the 'International Connectivity' maps are firmly embedded in the conventions of statistical cartography. They use a choropleth approach, based on a fourfold nominal classification, to denote network connectivity at the national level (Figure 5.4). The first class, 'No Connectivity', is represented by yellow shading; the two intermediate categories of connectivity - 'EMail Only' and 'BITNET but not Internet' - are symbolised by green and red shading respectively; and the 'top' category of 'Internet' connectivity is represented by a purple colour. The world base map of countries is wholly conventional, taking a familiar Robinson-type projection centred on the prime meridian. Countries are rendered as black outlines, easily filled with bright, solid colour. No countries, oceans or other features are labelled; there is no geographic context shown beyond the country outline acting as a vessel for the statistic. Clearly, it is assumed that the readership will know the conventions of world maps and be able to interpret the statistic appropriately as showing worldwide convergence to complete Internet connectivity.

The classification scheme is set out in the large legend box that dominates the centre of the map layout. The legend box also gives the title of the map, 'International Connectivity', along with revision details. The title itself is somewhat ambiguous if the maps are read out of context. Connectivity to what? The word 'international' in the title must also be noted so the reader understands what is being shown and what is *not* shown (see discussion below regarding data collection methodology related to the survey on which the maps are based). The labels for classes in the legend are also cryptic for readers without prior knowledge of computer networking. What, for example, are BITNET and UUCP? (Where these maps are employed intertextually the legend text is often simplified to aid comprehension.) It is also not explained what the significance is of the difference between the classes of connectivity. How is BITNET different from Internet? What does it denote for a country to be shaded red rather than green in terms of online access for people living there? There is no explanation on the map artefacts themselves, although some further details are given in associated data tables (Figure 5.5; see discussion below).

Besides the legend box, there are two other textual elements in the map layout. These denote background information on the map in terms of authorship and distribution. They also work in a connotative sense to grant additional authority to the statistics on the map. On the right hand side is a formal sounding copyright statement that says of the work: 'this map is formally published'. *De facto* credibility is also bestowed on the map's validity by citing the Internet Society (ISOC)[9]. The left hand text 'opens up' the map to the world in a sense, by proclaiming it to be freely and anonymously available online. This text also subtly exudes technocratic power by the statement of the ftp access method and the URL; particularly so as the first of the maps were published in 1991-93, pre-Web mainstream, when only the cyber-*cognoscenti* would have been able to meaningfully decode this text.

Taken as a whole, the textual elements of the map promote the work as a quasi-official statement on Internet globalisation. A techno-scientific aesthetic can also been seen in the overall map composition: the unadorned, sparse and perfunctory style of scientific representation, drawn on ascetic white space. This outward 'matter-of-fact' simplicity in design results mainly from expediency in production. However, the effect - I would argue - is the production of an *authoritative* looking map and one that epitomises the *authoritarian* imposition of the 'statistical' vision *onto* the world, *ordering* Internet globalisation by country

[9] This is a significant U.S.-based lobby group working to support the 'progressive' development agenda for the Internet. In the mid 1990s it enjoyed considerable influence as the 'voice of the Internet' in policy debates with the U.S. government and international forums. Today, its influence in shaping the structure of the Internet has diminished considerably.

and by classes. The 'International Connectivity' maps display the prevailing de-socialising *modus operandi* of most thematic mapping.

5.4.1.2 Patterns of Internet globalisation in the 'International Connectivity' maps

How, then, do Landweber maps denote the geography of global Internet diffusion through the 1990s? A casual inspection of the first map from 1991 presents a world where pretty much all developed countries were connected to the Internet (most had been linked to NSFNET during previous three years), but at the same time a large number of the world's nations were shaded yellow, indicating that they had no international network connectivity. In fact, this category included about half of the world's countries, though these were clearly concentrated in the less developed regions of Africa and central Asia. The connotation is of a complicated and fragmented pattern with significant differences between parts of the world, including wide divisions in connectivity between neighbouring countries (e.g., the purple shaded India in the highest category bordering the yellow coloured Pakistani and Bangladesh in the bottom class of 'no connectivity').

Jumping forward in time to the final 'International Connectivity' map produced for June 1997, the vast majority of the nations of the world were shaded purple. The Internet, measured according to Landweber's survey methodology and classification scheme, was so widespread that by 1997 the exceptions really stand out on the map. The connotations are markedly different to the 1991 with a much more uniform pattern across the world and much reduced difference evident. The 1997 map is a representation of convergence and implies that the globalisation of the Internet will be imminently complete. It was at this point that tracking diffusion at this scale became largely redundant and, hence, this was the last map in the series produced by Landweber. (An amended map was created later in 1997 by activists Mike Jensen, with slightly adapted classification, to show the updated networking situation in Africa; map reproduced in appendix two, Figure A2.4.)

By 1997, then, this mapping of Internet globalisation showed a pristine purple-coloured world, pockmarked with bright yellow spots. These remaining 'unwired' spots were nations suffering from extreme poverty, war and civil conflicts (such as Afghanistan, Bhutan and Somalia) or from geopolitical isolation (e.g., Libya, North Korea, Burma, Iraq and Syria). More than ten years after this map was produced, many of these yellow 'No Connectivity' countries are still marginal to the Internet world[10]. Indeed, in some globalisation discourses they are stigmatised as 'failed' states, with a number being actively demonised as part of an (illusory) 'axis of evil'. These 'unwired' places are being shifted, in certain geopolitical circles, from a moral *problem* of underdevelopment to a security *threat* to globalised peace[11].

A particularly pernicious example of such a construction of new threats of the 'unwired' is set out in the 'Pentagon's New Maps', a provocative template of twenty-first century U.S. geopolitics produced by defence analyst, Thomas Barnett (map is reproduced in appendix two, Figure A2.5). In his mapping, he asserts that "disconnectedness defines danger" as the "new security paradigm that shapes this age" (Barnett 2003, no pagination). Unsurprisingly, Saddam Hussein's Iraqi regime was cited as the prime example of a nation that was seen as "dangerously disconnected from the globalizing world, from its rule sets, its norms, and all the ties that bind countries together in mutually assured dependence" (Barnett 2003, no pagination). This new security challenge for U.S., therefore, *justifies* pre-emptive action to re-connect the disconnected nations, by military means if necessary. As Roberts' *et al.* (2003, 895), in their trenchant critique of Barnett's neoliberal re-mapping of the world, argue it justifies "intervention in the cause of forcibly removing obstacles to globalisation."

5.4.1.3 Authorship of the 'International Connectivity' maps

Unlike most statistical maps, the 'International Connectivity' series has a clearly identified human author. The maps were solely the work of Lawrence Landweber,

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[10] As note above in the discussion of the 'DOI' map, Afghanistan,, Iraq, North Korea and Somalia appear to be in a strange category of having no digital opportunity ranking but being denoted cartographically.

[11] Although as pointed out by Vujakovic (notes on thesis draft, October 2006) this is a narrow and extreme perspective even in geopolitical circles, yet even with limited support it still has some influence on wider development and diplomatic discourses.

whilst a professor in the computer science department at the University of Wisconsin-Madison, where he worked for over thirty years. Initially, Landweber's research interests lay in theoretical computer science but from the late 1970s he become one of the pioneers in the development of academic networking in the U.S., being the prime mover in the building of TheoryNet in 1977 and CSNET at the start of the 1980s (for details, see Cromer 1983). These networks complemented developments then taking place with ARPANET (cf. Abbate 1996; Hafner and Lyon 1996) and were themselves significant milestones along the road towards the modern Internet. The success of CSNET, in particular, was an important factor in securing government funding for NSFNET (Randall 1997). Landweber's breadth of professional work over two decades clearly demonstrates his commitment to spreading the benefits of computer networking as widely as possible: "Starting in 1982", Landweber notes, "we made contact with CS [computer science] groups in other countries and held workshops with people from around the world who were building national networks. The networking idea was awakening everywhere in the world" (quoted in Randall 1997, 120). He was involved in founding the Internet Society and he served as the society's President for two years. He was instrumental in founding the society's Developing Country Workshops, beginning in 1993 – cited as a vital element in Internet 'bootstrapping' (Guédon 2002).

Why did Landweber track and map the global diffusion of network? Given his academic background, the desire to inform and educate the wider community of interest through the free, timely dissemination of accurate information was important; and given his commitment to the 'diffusionist' cause, the maps were likely not purely academic productions, they were created as tools of persuasion to encourage greater efforts to connect up the 'unwired' nations. This last motivation is articulated in a revealing comment Landweber made in a 1995 *New York Times* article: "Everyone realizes that Africa is lagging .... you look at the map of Africa and you see huge gaps all over that will prevent this continent from participating in so many aspects of life on this planet as it is developing" (quoted in French 1995, 5). His efforts in this regard, should be read as altruistic rather than commercially-driven promotion for personal gain.

While the Internet has grown tremendously in the last ten years Africa remains the least connected region in the world, and the digital gap between it and the developed world is, arguably, widening not narrowing. In illustration of this, Landweber was again quote as a authority figure in network developing in a New York Times over twelve year later but echoing similar 'diffusionist' sentiments: " 'Unless you can offer Internet access that is the same as the rest of the world, Africa can't be part of the global economy or academic environment," said Lawrence H. Landweber, professor emeritus of computer science at the University of Wisconsin in Madison, who was also part of an early effort to bring the Web to Africa in the mid-1990s. "The benefits of the Internet age will bypass the continent." (Nixon 2007, no pagination). Empirical evidence to support the widening gap thesis put forward in this news story was provided by two choropleth maps of Africa showing national-level per capita penetration of Internet and mobile telephones.

5.4.1.4 Methodology of the 'International Connectivity' maps

To understand the 'International Connectivity' maps and the perspective on Internet globalisation they produce, it is important to have a sense of what they are measuring and how the measurement was undertaken. Essentially, Landweber was enumerating the availability of computer networks according to two key characteristics: that connections were international in nature and that they were publicly accessible. 'International' chiefly meant connected to the U.S. and 'public' effectively meant that some institutions (most often universities) were reachable to general users outside the country. (The degree to which connectivity and public reachability in *both* directions was verified by Landweber is not clear.) Landweber was solely concerned with the *presence* of an international link, with no recording of the capacity, cost or reliability of the links (which would have clearly been prohibitively time consuming to attempt to gather at worldwide scale). Furthermore, measurement did not enumerate the extent of internal networking provision and intentionally did not register private networks (such as military links or proprietary business networks like the airline reservation system).

The data was collated and presented in summary form at the country level at regular intervals (shown Figure 5.5). Like any survey methodology, Landweber's was a compromise; as Press (2000, no pagination) points out: "[k]eeping track of only one easily defined variable allowed [Landweber] to maintain a global perspective at a reasonable cost, but this system was limited by the fact that differences among and within nations were hidden."

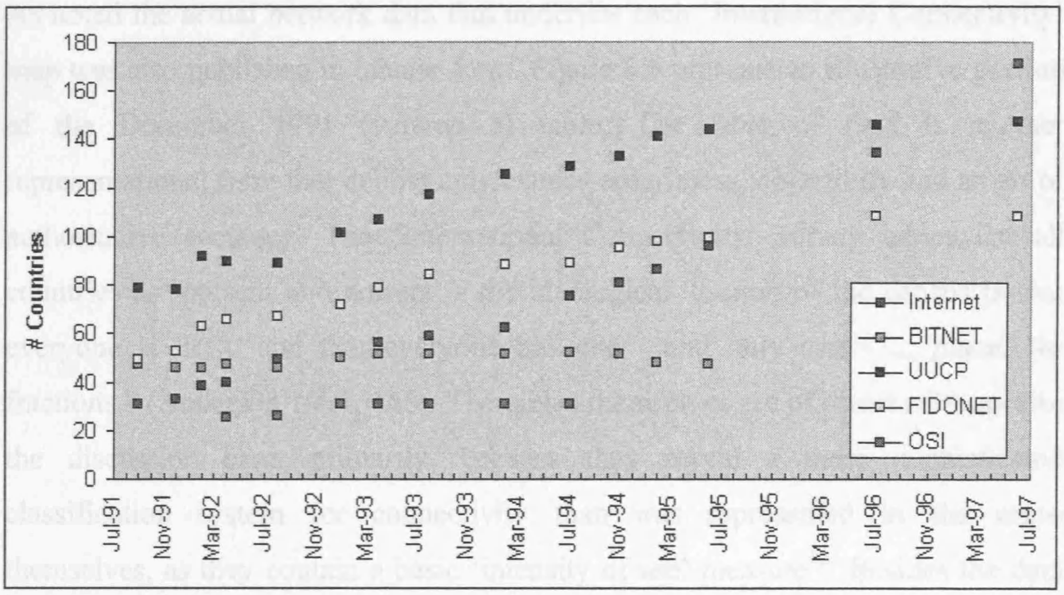

Figure 5.5: A longitudinal chart of "worldwide network growth" showing the range of network types covered by the 'International Connectivity' survey and the periodicity of their publication. Note, not all surveys were accompanied by a map. (Source: Zakon 2004.)

Details on the changing state of network connectivity in different countries were returned to Landweber's 'centre of calculation' (Latour 1987) at the University of Wisconsin-Madison, from a human network of knowledgeable 'locals' across the world. The maps were, therefore, in some senses built by many hands from voluntarily submitted data (explicitly acknowledged in the data tables, see Figure 5.6). Besides collecting data from the field, Landweber was also an 'insider', with intimate knowledge of ongoing networking activities, particularly those related to NSFNET's international connection scheme (see Goldstein 1995). He was also knowledgeable to be able to exploit technical information and statistics published by the consortium that ran the NSFNET backbone. Once the early 'International Connectivity' surveys began to circulate he also received feedback from readers (again, this was explicitly encouraged in the header of the data tables, see Figure

5.6 below). Overall, it is evidently a pragmatic way of assembling such global information at a low cost (remembering this project was very much a 'one man' effort), although others tried direct technical measurement methods, using the Internet as measurement tool to scan computer connected to different networks (cf. Dodge 1999b, 2000d; Quarterman *et al.* 1993, 1994).

As noted the actual network data that underlies each 'International Connectivity' map was also published in tabular form. Figure 5.6 presents an illustrative portion of the December 1991 (version 3) table. The table of data is another representational form that deliberately exudes orderliness, objectivity and an air of authoritative accuracy. The 'International Connectivity' survey tables list all countries as 'present and correct' - the ideological "fiction of the census is that everyone is in it, and that everyone has one - and only one - ... place. No fractions." (Anderson 1991, 166). The tables themselves are of direct relevance to the discussion here, primarily, because they reveal a more sophisticated classification system for connectivity than was represented in the maps themselves, as they contain a basic 'intensity of use' measure[12]. Besides the data classification, the table headers also contain some useful information for contextualising Landweber's project, including acknowledgement of sources and often succinct remarks on the precision (or otherwise) of the data (e.g., 'Information on Slovenia/Croatia/Yugoslavia and former Soviet Republics may be incomplete', from the April 1992 survey table). The admission of potential faults in the data (in the mode of a 'modest witness', see chapter four) can contrasted with the cartographic certainty of denotation by the maps. An orderly visual presentation on the choropleth maps does not only reveal, it can most effectively hide a multitude of sins in the underlying data[13].

[12] Countries were categorised into the 'minimal' use class if they had fewer than five known sites publicly connected and this was indicated with a lower case letter. Countries with more than five sites were classed as having 'widespread' connectivity and this was denoted by a capital letter.

[13] The capacity to show statistical uncertainty in a useful and meaningful way is a largely unresolved area of cartographic research (cf. Dietrick and Edsall 2008; MacEachren *et al.* 2005).

```
INTERNATIONAL CONNECTIVITY
Version 3 - December 2, 1991

Please send corrections, information and/or comments to:

Larry Landweber
Computer Sciences Dept.
University of Wisconsin - Madison
1210 W. Dayton St.
Madison, WI 53706
lhl@cs.wisc.edu
FAX 1-608-265-2635

Include details, e.g., on connections, sites, contacts, protocols,
etc.

Thanks to the many people from around the world who have provided
information.
-----------------------------------
In the following, BITNET is used generically to refer to BITNET
plus similar networks around the world (e.g., EARN, NETNORTH,
GULFNET, etc.).
---------------------------------
SUMMARY

NUMBER OF ENTITIES WITH INTERNATIONAL NETWORK CONNECTIVITY = 89

BITNET Col. 2  (Entities with international BITNET links.)
      b = minimal < 5 domestic sites =  18
      B = widespread >= 5 domestic sites = 28
      x = uncertain = 2
INTERNET Col. 3  (Entities with international IP links.)
      I = operational = 33
      i = soon available = 3
UUCP Col. 4  (Entities with international UUCP links.)
      u = minimal  < 5 domestic sites = 40
      U = widespread >= 5 domestic sites = 38
FIDONET Col. 5  (Entities with international FIDONET links.)
      f = minimal  < 5 domestic sites =  10
      F = widespread >= 5 domestic sites =  43
Col 6 = * = New connections expected in near future.

 ----  AF   Afghanistan (Republic of Afghanistan)
 ----  AL   Albania (Republic of Albania)
  [......records deleted......]
 ----  CK   Cook Islands
 b-u-  CR   Costa Rica (Republic of Costa Rica)
 --u-  CU   Cuba (Republic of Cuba)
 b-U-  CY   Cyprus (Republic of Cyprus)
 BiUF  CS   Czechoslovakia (Czech and Slovak Federal Republic)
 BIUF  DK   Denmark (Kingdom of Denmark)
```

Figure 5.6: Part of the 'International Connectivity' data table produced by Landweber, December 1991. (Source: <ftp.cs.wisc.edu/connectivity_table>.). Full data table is reproduced in appendix two, Figure A2.6.

5.4.1.5 Distribution of the 'International Connectivity' maps

In the 1990s the 'International Connectivity' maps are some of the most widely seen geographic maps of the Internet. They are still cited and used several years later (see examples below). There are several factors that can be advanced to explain why they have enjoyed such wide distribution:

- Easy to get: All of the 'International Connectivity' materials were and remain publicly accessible online via anonymous ftp (and now through the web) from his department at the University of Wisconsin-Madison. The online location is widely disseminated and cited. Further, the address has remained active since the project started in 1991.
- Easy to read: The file formats used by Landweber for the maps and data tables mean that they are still all readable today on common computing platforms without the need for specialised software. The avoidance of proprietary formats (e.g., particular spreadsheet formats for the tables or GIS package for the maps) has been important for long-term accessibility. The file sizes for the materials are also small, making downloading possible for people with slow Internet connections (a significant issue for many people when the survey began back in 1991).
- Easy to understand: The materials are clearly named and quite straightforward to understand in a normative sense. As stated earlier, the choice of choropleth mapping provides an ostensibly familiar and comprehensible cartographic design. The materials are all labelled with dates and it is easy to work out which is the most up-to-date version.
- Free to use: Explicit permission is granted for unlimited reproduction of the materials in the copyright statement on the maps and tables. This is a small but important factor. By removing the burden in obtaining formal copyright release, Landweber was encouraging the widest possible dissemination of his maps. Free access and dissemination clearly stems directly from Landweber's academic position, founded as it is on the open publishing model with results distributed non-commercially, in marked contrast to other valuable Internet statistics and maps, which are available only in expensive reports for the corporate market (e.g., those produced by IDC and TeleGeography).

- Authoritative source: There are several interlocking factors that work to promote the trustworthiness of the 'International Connectivity' materials, such that people are confident in using them as factually accurate representations. Firstly, the authorship of the materials is clearly stated and this lends considerable weight to their probity. The author, Landweber, is a respected professor, well known in the field of research and education networking, and affiliated with a major U.S. university. As noted above, the endorsement of the Internet Society was also overtly employed.
- 'Scarcity breeds success': A last reason for the success of the 'International Connectivity' maps is that there was little in the way of competition, especially in the early 1990s. There were few other maps produced which offered as synoptic and simple - and perhaps one might say seductively simple - view of the Internet on a single map. Most other maps tended to be more technical in nature, showing specific networks or specific countries using link-node graphs. Even today, very few 'high-level' statistical maps of the 'whole' Internet are produced to match the effectiveness of the 'International Connectivity' maps, which are easily accessible and have consistent presentation over time[14].

5.4.1.6 Influence of the 'International Connectivity' maps

Considered in combination, the semiotics of the images, their authorship and the mode of distribution, mean that the 'International Connectivity' maps are apposite examples of what Latour (1987) called 'immutable mobiles'. Truthful, scientific knowledge on the extent of networking across the globe was constituted at a 'centre of calculation' from various pieces of survey data. This knowledge was purposefully inscribed into maps and tables to stabilise the knowledge in fixed, conventional forms. The maps and tables are said to be 'immutable', remaining the same wherever and whenever they are read. The maps and tables as readable files, distributed on the Internet, were easily 'mobile', freely circulating online and in print and being usable in a wide range of contexts, including translation

[14] The maps of the Digital Opportunity Index discussed in section 5.4.2 suffer because of a change of colour ramp from one version to the next making like-for-like comparisons harder.

into other languages (see Figure 5.8 below). Lastly, the maps were combinable in many ways and many discourses.

Regarding the 'International Connectivity' maps as 'immutable mobiles' is useful because it starts to unravel the underlying truth claims they are working to establish. As Cosgrove (2003, 136) asserts, maps work because they "permit scientific discourse to sustain its claims of empirical warranty and repeatable truth in the absence of eye-witness evidence." Most people have no means of assessing first hand the globalising of the Internet. They had to rely on the 'International Connectivity' maps to establish the *truth* of the Internet diffusionists' viewpoint by showing that country x was connected. The maps are powerful 'immutable mobiles' because so many people are willing to accept them as truth, as can be seen in the extent to which they have been cited and re-used intertextually. If Landweber had failed to secure immutability, then the maps would not be able claims to be anything "more than an imaginative picture" (Cosgrove 2003, 137).

The 'International Connectivity' maps have been cited and reproduced numerous times in newspapers, popular books, academic papers and policy-related reports in the last decade, contributing as pictorial evidence to a range of discourses on the 'state of the net'. Apparently, they were "displayed triumphantly at the various Inets [ISOC conferences] to mark the fact that the Internet was gallantly going global; this was exciting!" according to Guédon (2002, no pagination). The data tables were widely posted to mailing lists and Usenet newsgroups throughout the 1990s. Long after the end of Landweber's updating of the maps (in June 1997), they still continue to attract interest[15].

[15] For example, a search of the Web, as indexed by the Google search engine, in January 2008 returned 315 pages containing hyperlink citations to the 'International Connectivity' maps, quite an impressive measure considering the material has not be updated for over ten years now.

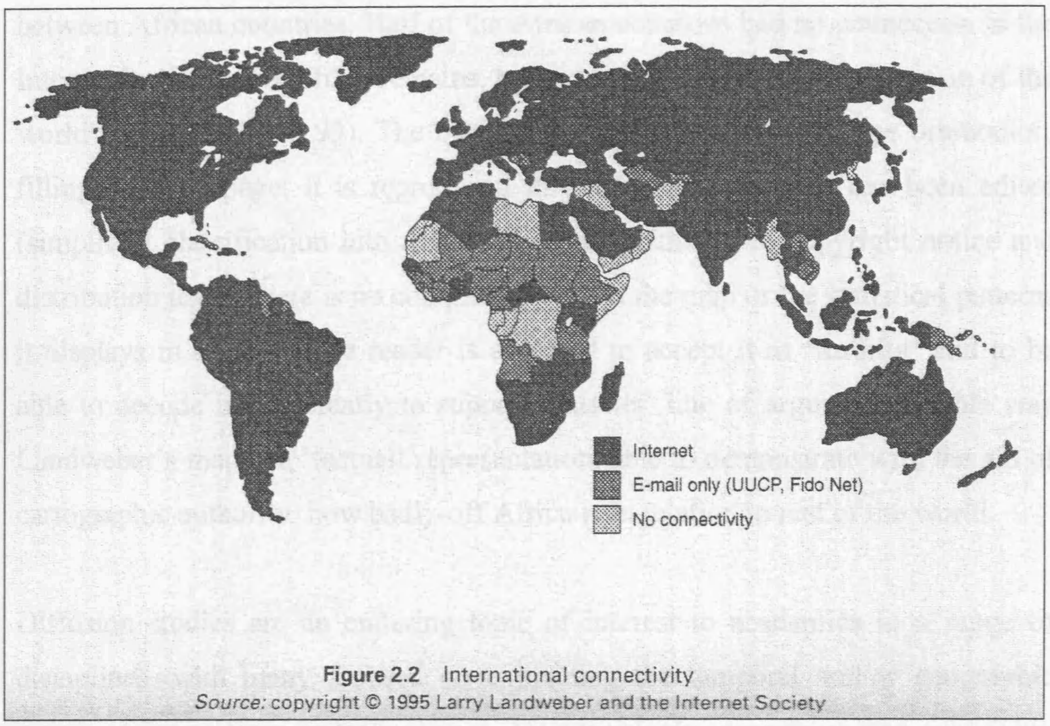

Figure 5.7: Intertextual example of the deployment of a simplified 'International Connectivity' map in a narrative about development in an academic monograph. (Source: author scan from Castells 1998, 94.)

In the majority of cases Landweber's maps and data tables have been intertextually deployed as unproblematic and objective evidentiary material, which supports the 'truthfulness' of rapid Internet diffusion - simple maps of a successful Internet, successfully spreading across the world. In terms of more scholarly works, the 'International Connectivity' materials have been deployed by several academic authors as matter of fact evidence (e.g., Choucri 2000; Crampton 1999; Grundy 1997; Leiner 1993). A typical example was the use of a connectivity map by Manuel Castells in the third book in his 'network society' trilogy, *End of Millennium* (1998). The map was the sole illustration for the section titled 'Africa's technological apartheid at the dawn of the Information Age' (Figure 5.7). The discourse expounded by Castells' is a broadly 'diffusionist' one about 'failing Africa' and the need to quickly counteract technological underdevelopment. The citation to the map in the text follows this clear articulation of the infrastructure 'failure': "Connection to the Internet is very limited because of insufficient international bandwidth, and lack of connectivity between African countries. Half of the African countries had no connection to the Internet in 1995, and Africa remains, by and large, the switched-off region of the world" (Castells 1998, 93). The map itself is presented in landscape orientation, filling a whole page; it is reproduced in black and white and has been edited (simplified classification into three categorises, removal of copyright notice and distribution text). There is no commentary about the map or the statistical patterns it displays in the text. The reader is assumed to accept it as 'truthful' and to be able to decode it sufficiently to support Castells' line of argument. In this way Landweber's map is a 'factual' representation, able to demonstrate with the aid of cartographic authority, how badly-off Africa is in relation to rest of the world.

Diffusion studies are an enduring topic of interest to academics in a range of disciplines, with many focused on explaining the temporal and/or geographic waves of innovations in technologies. Unsurprisingly, describing and explaining the global spread of the Internet through the 1990s sparked a number of studies (e.g., Arnum and Conti 1998; Batty and Barr 1994; Elie 1998). These studies commonly used country-level analysis of per capita measures of Internet availability in some form of regression modelling to find explanatory 'independent' variables and to fit a growth curve. A number of these studies have utilised the 'International Connectivity' data as a 'truthful' source for the dependent variable in their analysis. For example, Hollis (1996) used Landweber's data tables from 1991 and 1995 to produce a binary indicator of network connectivity and chart how this improved over time in relation to the UN Human Development Indicator (HDI) groupings of nations. Drori and Jang's (2003) analysis used the 'International Connectivity' data to construct an eight-level 'Net Sophistication Score' with change between 1991 and 1995 compared and then explained in a regression model. The 'International Connectivity' data are used essentially to show that things are getting better, and getting better quickly - which in a sense they are. For example, Goodman *et al.* (1994, 31, emphasis added) note: "Landweber maintains an *extensive* and *verified* 'International Connectivity Table' ... regularly updated and published in the Internet Society News". However, as explained above, these data are a very limited sampling, only accounting for the presence of connectivity and taking no account of the capacity of Internet connections, their availability or how widely they are used.

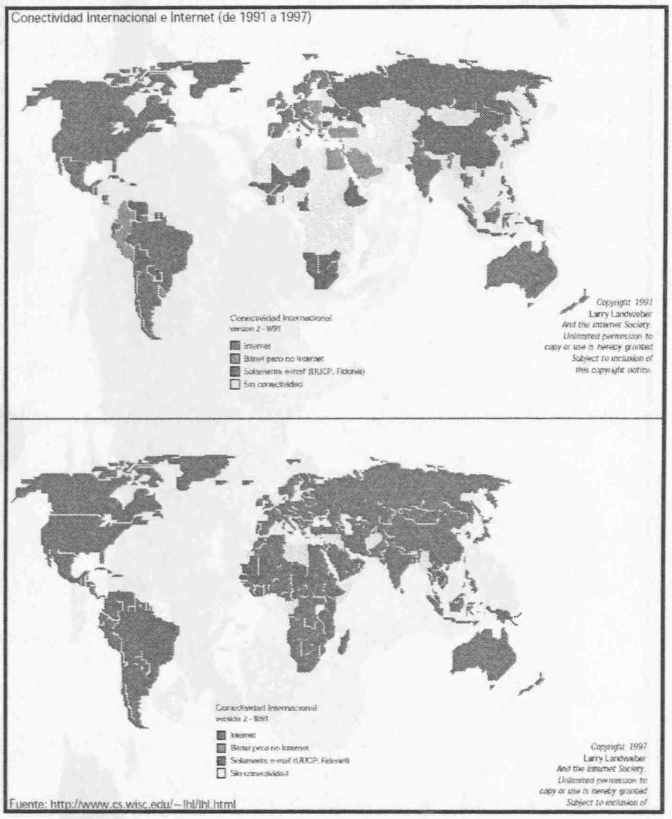

Figure 5.8: A creative adaptation of two 'International Connectivity' maps. The bottom map is wrongly labelled as 'version 2 – 9/91' when it is actually 'version 16 – 6/15/97'. (Source: Ministerio de Ciencia y Tecnología 2001, 4.)

'International Connectivity' maps and data have also been utilised in national and international policy documents, particularly in relation to the 'problem' of the digital divide and development. Illustrative examples include the 1995 UNESCO report titled *The Right to Communicate - At what Price?* which features an 'International Connectivity' map captioned as 'Research network connectivity as of February 1995', in a section discussing the problems of access for scholars in Africa. No interpretation was deemed necessary, again because of its self-evident claim to 'truth'. In another example from a Brazilian 'information society' policy document two maps are translated and employed in sequence to provide a simple narrative of 'progress' (Figure 5.8). The maps are redrawn on a much generalised country outlines and somewhat modified different colours.

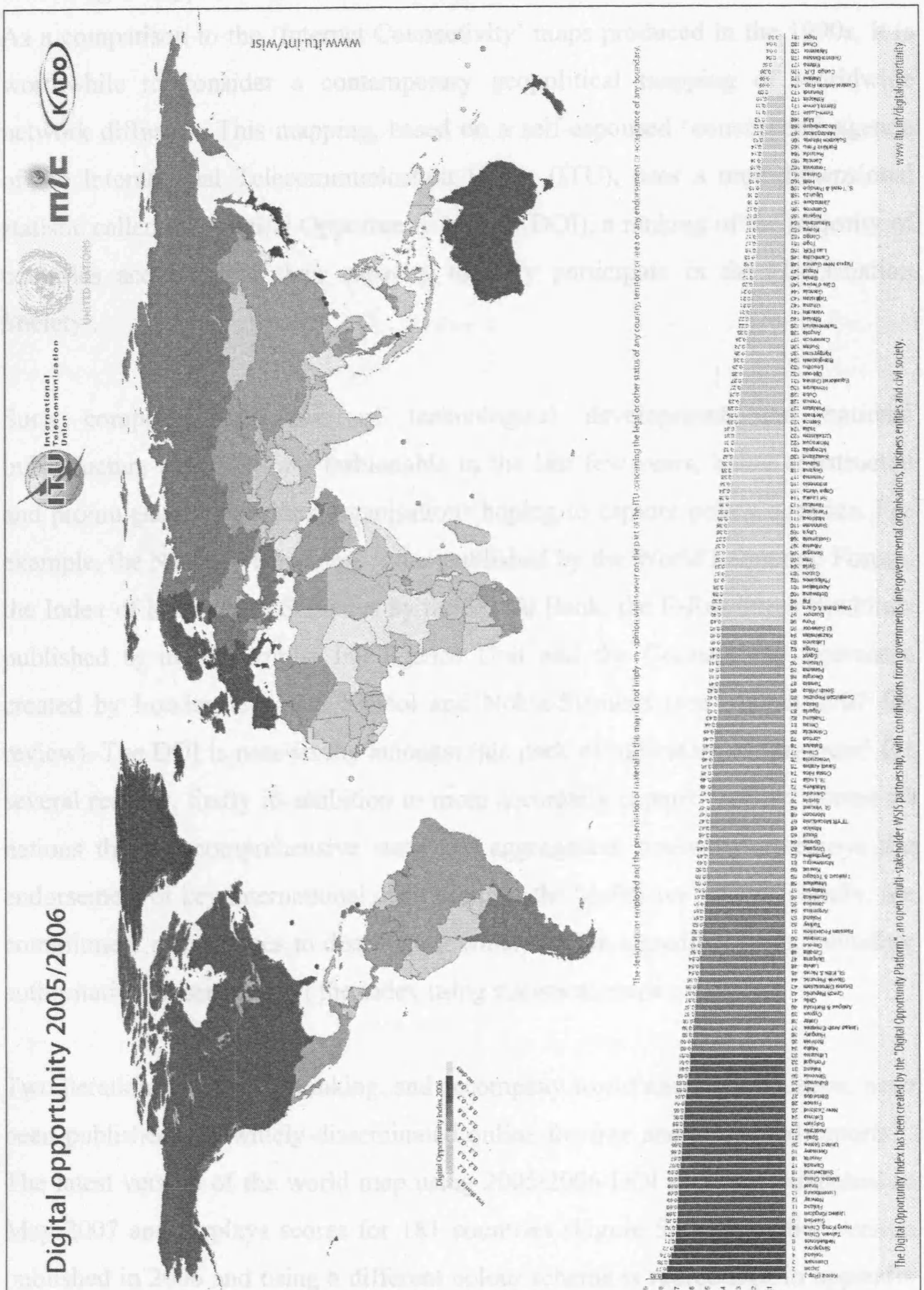

Figure 5.9: The 'Digital Opportunity 2005/2006' map created the International Telecommunication Union. (Source: WISR 2007, 150-51.)

5.4.2 'Digital Opportunity 2005/2006' map

As a comparison to the 'Internet Connectivity' maps produced in the 1990s, it is worthwhile to consider a contemporary geopolitical mapping of worldwide network diffusion. This mapping, based on a self-espoused 'convergent' agenda of the International Telecommunication Union (ITU), uses a multidimensional statistic called the 'Digital Opportunity Index' (DOI), a ranking of the majority of countries according to their capacity to fully participate in the 'Information Society'.

Such composite indicators of technological development and national infrastructure capability are fashionable in the last few years, being constructed and promulgated by various organisations hoping to capture policy agendas. For example, the Network Readiness Index published by the World Economic Forum, the Index of Knowledge Societies by the World Bank, the E-Readiness Rankings published by the Economist Intelligence Unit and the Connectivity Scorecard created by London Business School and Nokia-Siemens (see Mahan 2007 for review). The DOI is noteworthy amongst this pack of indicators of 'progress' for several reasons, firstly its ambition to more accurately capture 'reality' across all nations through comprehensive statistical aggregation. Secondly, it enjoys the endorsement of key international institutions as the 'definitive' index. Thirdly, the commitment of resources to distribute it widely and in a credible form, including authoritative presentation of the index using statistical maps.

Two iterations of the DOI ranking, and accompany world and regional maps, have been published and widely disseminated online for free and in printed reports[16]. The latest version of the world map using 2005/2006 DOI data was published in May 2007 and displays scores for 181 countries (Figure 5.9; the earlier version published in 2006 and using a different colour scheme is reproduced in appendix

[16] The map is distributed freely online, in high resolution PDF format. The map is afforded a significant visual presence on the main ITU web page promulgating the DOI, serving as a singular sign of technocratic authority ('look we have measured the whole world'). The map is also distributed in various ITU publications, including the DOI executive summary where it is located in the middle of the document on double page spread; in the large policy reports the map is somewhat hidden away at the end in the statistical annexes (WISR 2007).

two, Figure A2.9). As is evident, the cartographic design choice for the map is wholly conventional choropleth representation.

The construction of the DOI is one of the most sophisticated and well planned attempts to rigorously measure the global extent of ICT development, coming with high-profile endorsement of authoritative UN bodies and distributed in substantial, well produced reports (e.g., WISR 2007). The self-stated goal for the DOI, with its clearly implied political stance, is stated as follows: "a valuable tool for benchmarking ... that governments, operators, development agencies, researchers and others can use to measure the digital divide and compare ICT performance within and across countries" (ITU 2008, no pagination); "it provides a powerful policy tool for exploring the global and regional trends in infrastructure, opportunity and usage that are shaping the Information Society" (WISR 2007, 35).

In the outline descriptions of the DOI and its potential usefulness as a tool to inform policy, the nature of the 'Information Society' (always capitalised) is taken as given, it is a singular model ('Society' not 'societies') and one that by implication defaults to a Western-centric market model of consumer capitalism made, ultra competitive with computers and networks. There is no real definition of what constitutes the 'Information Society', although again implicitly one should take the characteristics of the leading nations in the index as archetypes (the role model of South Korea in particular, given the influence of its government institutions in the conceptualisation and design of the DOI[17]). The ITU perspective views the realization of the 'Information Society' as an epochal change with past socio-economic organisations[18]. It is a top-down, technocratic view of a particular kind of social relations imagined by elite bureaucrats in their

[17] Highlighted on the 'DOI' map are the logos of Korean Ministry of Information and Communication (MIC) and the Korea Agency for Digital Opportunity Promotion (KADO), see Figure 5.9 above.

[18] Some scholars have argued there is actually the emergence of different types of networked informational societies (e.g., Castells 1996). There are also sceptics who maintain that there is no such thing as the information society, and that changes in employment and industrial structures cited as prima-facie evidence simply reflect continuity with the past trends (e.g., Webster 1995).

offices in Geneva and Seoul. Yet, the 'Information Society' in the context of the ITU, and its view of the world, is accepted as a real achievable goal, that progress to this goal is inevitable and that reaching the goal is universally desirable. It is a strongly 'diffusionist' agenda where all countries are essentially journeying towards a single endpoint. The DOI is then a sophisticated statistical 'navigation' instrument to guide nations along a this linear and one-way path to the 'Information Society'.

The DOI is viewed as a particularly useful yardstick for lagging nation, because "developing countries are being left behind in the emerging Information Society – not just in basic infrastructure, but in their abilities to compete in service industries, experience and skilled labour" (ITU 2008, no pagination). The DOI's 'objective' statistical criteria do not just monitor but can be seen almost as an enforcement tool because of the individualised and consumption-orientated meanings embedded in very definition of 'digital opportunity'. According to the DOI overview web page (ITU 2008, no pagination) in an "ideal world" digital opportunity means:

- the whole population having easy access to ICTs at affordable prices,
- all homes equipped with ICT devices,
- all citizens having mobile ICT devices,
- everyone using broadband.

The agenda implicit in these objectives is clearly focused on neoliberal development through of market-based solutions and individualized actions. This kind of 'digital opportunity' is also clearly desirable and likely to be profitable for corporations making equipment and providing services.

5.4.2.1 Design of the 'Digital Opportunity 2005/2006' map

The 'Digital Opportunity 2005/2006' map is a world scale choropleth mapping of 181 countries classified into one of eight categories (Figure 5.9 above). The classification of the index values range between 1 and 0 (with 1 being the 'ideal' country with complete digital opportunity) and uses an equal sized intervals. Countries are shaded according to their class with a subdued pink-based colour ramp, running from beige to dark pink-purple. There is also a special category for 'no data' that shades countries grey and this seems to apply, noticeably, only to Western Sahara (the territories of Northern Cyprus and Puerto Rico are also in this category but this is only evident through close-up inspection using the zoom in the PDF document). The classification is denoted in a small legend left floating in the Pacific. The legend runs horizontally from 'low' to 'high' rather than the more typical vertical alignment. One could speculate whether the vertical arrangement was avoided because it denotes a hierarchy from 'bad' at the bottom to the 'best' performers at the top that connotes a value judgement from the institution behind the map.

The map is likely in Plate Carrée projection, with the conventional Atlantic centred orientation which places Western Europe in the focal point of the representation and splits the Pacific Ocean. This projection tends to be 'default' generated in GIS packages for world maps. (Indeed, Figure 5.9 has, subjectively, the feel of a GIS-generated map, being somewhat clinical in execution with overly detailed boundaries and distracting smattering of tiny island; it is lacks the subtleties and polish of a hand-finished map.) No countries are identified and no geographical features are labelled, the cartography is a purely functional graphic to display the DOI statistic. (Note, the regional-level DOI maps do label countries, see section 5.5.2 below.) The only prominent natural geographical feature evident are the large lakes which stand out from the background surround because of their silver-blue colouring. There is no overt cartographic paraphernalia such as a scale or graticule – it is a simplified image of the world that that seems to merely denote the statistics, it is striving to be as conventional as possible so it artifice and constructed nature disappears from view. The bureaucratic origins and supposed mundane nature of its viewpoint is subtly reinforced by the literal small print running under the map which denotes explicitly in writing that the map does not show precisely what it does connote - that of nation state boundaries. The map, stamped with the UN logo clearly does signify as a powerful visual 'endorsement' and 'acceptance' of all the boundaries drawn in spite of the disclaimer. As such, the caveat is legalise and typical on the documents of such global institutions that connote a great deal of meaning but can not denotatively admit to it.

The map elements themselves are floating on a empty white background and are surrounded by supporting graphical material that denote its origins and work connotatively to establish its authority as an reliable representation of the state of the world. Although this somewhat undermined because the title is rather ambiguous in itself – what does 'digital opportunity' mean and what does the split date of '2005/2006' indicate? The dual date is explained in the technical notes in the accompanying report that the part of the input data for the DOI comes from 2005 and the other from 2006. Conceptually, this is a somewhat problematic issue that makes it hard to place the map at a definite point in time (and different from the temporal precision indicated on the 'International Connectivity' maps, Figure 5.4 above). Most statistical maps seek to denote their point of reference in time exactly so as not to connote uncertainty in the reader. Beside the title, the top of the map is stamped with four corporate logos of the institutions involved in the production of the index statistics and the map. These are stamps of approval from institutions with global credentials and connote integrity on the representation below. The logos are also denotative marks the ownership rights over the map and, by implication, the world, much like heraldic signs surrounding Renaissance maps denoted the patronage of the map and also connoted forcefully their power over the territory represented in the map. Given the internationalist agenda of these organisation, it is not surprising that they all have a logo premised to some degree on the iconicity of globe. The ITU's logo is a state-less globe formed of the graticule alone, the famous UN logo shows the whole continents in unity from a polar projection, the MIC (Ministry of Information and Communication, Korea) logo has a small globe forming the dot over the 'i' and, lastly, KADO (Korea Agency for Digital Opportunity Promotion) with the most abstract globe symbolism hinted at through the oval swirl.

The bottom third of the whole map page is dominated by an elongated bar chart that runs the full width of the world and shows all 181 countries rank according to their DOI score. This ranking from high to low creates a very even slope from the best to the worst performers. The bars are colour coded to match the classification and shading of the map and the subtle colour ramp combined with the smoothness of the slope connotes a systematic, almost natural, ordering of the nations of the world. It would be interesting to speculate how the bar chart would connote if ordered differently (e.g., alphabetical order or by population) and the degree to which it would give a discordant impression of the world's digital opportunity. The bar chart acts as a visual support, holding the world aloft (a role often taken by a distorted Antarctic continent in this projection) and has utility for the reader as a index to aid identification of countries by matching with the colour categories on the map. Although, the order of classes in the bar chart runs in the opposite direction to the small legend above it which is somewhat poorly thought through design. Denotatively the bar chart scale only goes up to 0.9 and not to 1.0. This is a somewhat sly design practice that makes the countries seem to be better performing that they are, and in particular it connotes positively for the top performers making them appear to have achieved near complete digital opportunity.

The final component to consider in the overall presentation of map is a text box running along the bottom of the page that seeks to explain, and in some senses justify and legitimate, the data displayed in the chart and map above. The text stresses, in the currently in-vogue language, that it results from an 'open multi-stakeholder WSIS[19] partnership' with a list of organisational types contributing – governments, international agencies, corporation and civil society. (Connotatively one assumes the order of organisations indicates their signification in the partnership.) Denotatively, the tag line is stating this is not the usual 'top-down' developmentalist[20] attempt to measure the world into orderly existence but rather an inclusive and participatory process. However, by feeling the need to state their

[19] WSIS acronym is not explained, it is assumed to be important and well known. It stands for 'World Summit on the Information Society'.

[20] Developmentalism is a critical description of the agenda and working practices of international agencies, Western governments, some large NGOs and aid charities that have become a self-sustaining industry with a set of top-down models of modernisation and economic growth that get rolled out regardless of local contexts. It is particularly associated with one-size-fits-all structural adjustment and marketization policies promulgated from the air-conditioned offices of institutions such as the IMF and World Bank that critics argue work to advantage of Western interests above improving the welfare of people in impoverished countries. Easterly (2007, 1) argues that developmentalism operates ideologically because it "promises a comprehensive final answer to all of society's problems, ... and it tolerates little dissent.". Statistical indicators, 'explanatory' scattergrams and simple shaded maps are instrumental tools of the intelligentsia of developmentalism, helping to manage the delivery of modernisation and inevitable progress out of poverty.

'openness' credentials explicitly, arguably, connotes the opposite view and making one question quite how inclusive the process actually was. The inclusion of the web address at the end of the text box is a denotative aid to locating further information, but also work connotatively as a citation for credibility – by willingness to show your sources of the material represented (see also discussion of the techniques of virtual witnessing and constructing signs of authority in chapter four). Overall, many of the established techniques for connoting integrity and veracity of a map supposedly without a point of view are in play in the 'Digital Opportunity 2005/2006' map. It is effective at connoting the impression of being unbiased and straightforward presentation of the world that can be trusted.

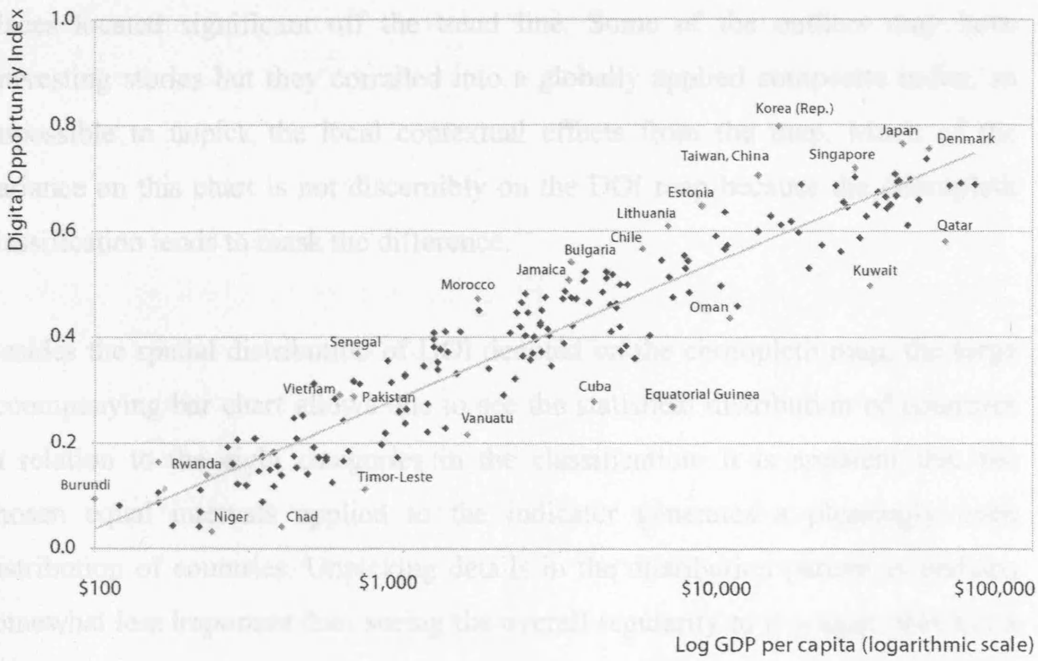

Figure 5.10: The relationship between national wealth and DOI. Countries above trend line could been seen to be performing better than predicted for their GDP, those below the trend line could be said to be under performers. (Source: author scan from WISR 2007, 39.)

5.4.2.2 Patterns of Internet globalisation in the DOI map

What does the 'Digital Opportunity 2005/2006' map denote about the state of the world? The overall geographic pattern of the DOI score represented is quite predictable, with no real surprises about the places in world that are classed as the 'best' and the clusters of nations that perform poorly at the opposite end of the classification. The distribution is denoted clearly from dark to light shading of countries (connotatively from 'healthy' and 'full' to a 'pallid and 'empty' appearance) and follows, broadly, established North – South global divides, with the large Australian landmass standing out in ('healthy') pink as the usual odd-one-out in uniform pattern across the southern hemisphere nations. The predictability of the overall pattern, for anyone who has some sense of global socio-economic performance, points to the fact that the DOI is essentially a statistical proxy for national wealth. Despite it being a sophisticated index measure, combining eleven ICT variables, DOI correlates strongly against GDP with an unsurprisingly positive linear relationship (Figure 5.10).

As is the way with such summary statistical plots, most of the interest lies in the places located significant off the trend line. Some of the outliers may have interesting stories but they corralled into a globally applied composite index, so impossible to unpick the local contextual effects from the map. Much of the variance on this chart is not discernibly on the DOI map because the choropleth classification tends to mask the difference.

Besides the spatial distribution of DOI denoted on the choropleth map, the large accompanying bar chart allows one to see the statistical distribution of countries in relation to the eight categories in the classification. It is apparent that the chosen equal intervals applied to the indicator generates a pleasingly even distribution of countries. Unpicking details in the distribution pattern is perhaps somewhat less important than seeing the overall regularity to it – again this has a sense of a 'natural order' about it. This is particularly so with the anodyne classification intervals that do not relate meaningfully to human experience, so there is no valuative connotative meanings from that fact that El Salvador, for example, is in the 'higher' class 0.4-0.5, than Peru, which is adjacent with a near identical DOI score but, in a lower class. As with these kinds of world rankings, most prurient interest lies in the membership of the top and bottom classes. These two privileged categories have slightly fewer countries than the middle classes but their membership is as expected. In common with many other country-based Internet and technology ranking schemes produced over the last decade or so, the 'best' performing nations are always the southeast Asian and Nordic nations, and the 'worst' are, as ever, the impoverished states in central Africa. The actual relative ranking of countries to each other in the top and bottom classes is somewhat arbitrary (dependent on the particular vagaries of statistical calculation) and only really matters in terms of national pride and regional rivalries (e.g., the competition between Japan and Korea for top spot, or the enmity between Hong Kong and Singapore as the leading small Asian 'tiger' economy). The relatively poor performance of the USA, ranked only twentieth in terms of DOI, may surprise some readers unfamiliar with technology rankings but it is not out of the ordinary and reflects in large part the socio-economic polarisation of the country which tends to 'drag' it down such lists. There are no countries scoring at the very top of the DOI indicator (South Korea is ranked first with 0.80 out of a possible 1.0 (the top two classes are not denoted on the map legend and the top class is missing from bar chart scales). Equally, no country scores zero, although Niger comes close.

In terms of the classification of countries according to their DOI score and subsequent representation on the map there is an unexplained issue around a handful of 'problem' nations (derogatorily labelled by commentators as 'rogue states') of Afghanistan, Iraq, North Korea and Somalia. These countries do not have a DOI score and are not in the 181 ranked nations on the bar chart, yet from inspection of the map it is apparent that they have all been shading according to membership of the lowest class (light beige). Interestingly, they are not in the special 'no data' category but seem to occupy an unidentified position outside of the normal parameters of calculation. The lengthy report in which the map is published runs to 175 pages, including five pages of technical notes on the DOI calculation and data sources, makes no mention of the fate of these four countries in calculating DOI rankings. Connotatively, does this mean their scores were so low as to be too embarrassing to admit to?

An overall reading of the mapped pattern of digital opportunity in connotative terms is one of considerably order and harmony. Most geographically adjacent nations are in the same or similar classes. This fact, combined with the well chosen colour ramp, connotes a smooth transition from place to place across continents, a continuous, almost 'natural', spatial gradations in DOI which is reminiscent of the subtly changing patterns of vegetation between biomes on global landcover maps. (The orderliness of the geographic pattern is also reinforced connotatively by the almost perfectly even slope on the bar chart.) The 'natural' harmony amongst nations across the map only breaks down slightly with the more disorderly patchwork of nations in central/southern Africa and a small portion of southeast Asia. But even here there are few sharp divides between next-door neighbours (i.e. differences of two classes or more) that would seriously dent the convergent impression. Indeed, there are no chasms of difference where countries in the top class border directly to nations at the bottom of the ranking, unlike the disruptive clashes between top and bottom denoted in the 'International Connectivity' maps. The one exception to this is the digital opportunity 'fault line' running along the DMZ on the Korean peninsula, however, this is not visually prominent or intrusive to an overall orderly pattern across the rest of the mapped world and it can be easily explained away as an aberration from an earlier era of geopolitics.

The overall connotative meaning emerging from the 'Digitial Opportunity 2005/2006' map and bar chart is of a convergent world, with nations having much more in common than separating them. This notion of the world coming together is assisted by the faint, almost porous denotation of boundaries between countries. The result is an impression of large continuous blocks of the equal colour (e.g., North America, Western Europe, parts of South America). The connotation is different to that created by the 'International Connectivity' maps with their definite black line-work imply hard boundaries between nations. The choice of distinct and boldly differentiated colour to denote the four classes on the 'International Connectivity' map (suggesting marked difference between countries) also contrast with the progressive eight class colour ramp for the DOI map (suggesting only gradual variation between countries).

Overall, what does the DOI map reveal about the extent of digital opportunity? It is already extensively diffused across the world and most places are participating.

Even though there is some uneven progress to the ideal of the Information Society, virtually all nations are safely on route. In terms of the fourfold classification of meanings, it can be argued that the DOI map connotes a powerful convergent message about the world.

5.4.2.3 Authorship of the 'Digital Opportunity 2005/2006' map

The Digital Opportunity Index (DOI), underlying the map, is primarily a product of the International Telecommunication Union. The DOI was launched in May 2006 and is intended to track progress towards bridging the digital divide and implementing the outcomes of the World Summit on the Information Society (WSIS), a major UN conference held in two phases in Geneva in December 2003 and in Tunis in November 2005. Two iterations of DOI have been published so far. In authorship terms the DOI was conceived by technocrats and statisticians at ITU headquarters in Geneva, with collaboration from the Korea Agency for Digital Opportunity and Promotion (KADO) and the United Nations Conference on Trade and Development (UNCTAD).

The ITU is a long established although relatively little know specialised UN agency that facilitates global telecommunications through important but behind the scenes work in technical standards, setting tariffs and managing the allocation of radio spectrum. It has an explicit agenda seeking to promote "peaceful relations, international cooperation among people and economic and social development by means of efficient telecommunications services." (source: <www.itu.int/about>). It is headquartered in Geneva, one of the favoured world cities for such international organisations, and draws its main funding from member states and large corporations. As with many such international agencies it espouses transparency of operations, budgets and decision-making but remains remote from many of the constituencies and people it notionally serves. The ITU has also been criticised as being part of the developmentalist industry, in league with the interests of large telecommunications companies to sell more equipment and gain preferential access to new markets, and not working in the interests of consumers (Jordan 1999). In operational ethos it is focused on technical solutions with a preponderance for opaque and officious working practices (labyrinthine documents, myriad committees and 'high-level' meetings) with little delivered beyond perpetuating its own existence.

A core element in how ITU the influences industry and government is through gathering comprehensive range of data on the worldwide status of telecommunications and publishing select statistical analysis from these. Like many UN agencies, the ITU's published statistics enjoy significant legitimacy for being reliable and unbiased. They are widely utilised in studies by other organisations and academics as the 'gold standard' benchmark to measure against. They also have a powerful bureaucratic aura of authority because of their worldwide scale and year-on-year consistency. As such they are seductive in appearance, offering one of few means to quantitatively compare many countries across space and through time. Yet, like all large institutions what gets collected and published reflect as much the agenda of the organisation as they do the underlying social reality purportedly being represented (cf. Cornford 1999).

The ethos at the core of ITU agenda is based on the fundamental belief in positive interplay between ICTs and social and economic development. This is clearly articulated in the following text from November, 2005: "[t]he digital revolution, fired by the engines of Information and Communication Technologies, has fundamentally changed the way people think, behave, communicate, work and earn their livelihood. It has forged new ways to create knowledge, educate people and disseminate information. It has restructured the way the world conducts economic and business practices, runs governments and engages politically. It has provided for the speedy delivery of humanitarian aid and healthcare, and a new vision for environmental protection. It has even created new avenues for entertainment and leisure" (source: <www.itu.int/wsis/basic/why.html>). Yet, through much of the 1980s and 1990s the development of the Internet, at the vanguard of the 'digital revolution', occurred almost completely outside the orbit of the ITU and its standards, statistics and committees. In danger of becoming irrelevant in a changing market landscape, over the last few years the ITU has made conscious efforts to embrace the Internet 'revolution' and move away from narrow focus on telecommunications as an industrial sector to be managed. It wants to be seen to be representing, and setting agendas, for a much broader notion of the 'Information Society'. The creation and promulgation of the DOI, can therefore, be seen as a component in this institutional refocusing exercise, it is tool not merely for measuring the information society, but an active instrument (including colourful world maps) that proves how seriously and proactively the ITU is working to bring about the 'Information Society'.

5.4.2.4 Methodology of the 'Digital Opportunity 2005/2006' map

The DOI is a complex statistical index created by aggregating eleven separate indicators related to measurable aspects of ICT consumption, including cost, household access and market penetration. Six of the eleven indicators relate to fixed line telecommunications and five are geared to mobile infrastructure. The DOI documentation stresses that these eleven input indicators can be usefully categorises into three component parts of 'digital opportunity'. The average of the three components are combined with equal weights into an overall score. The indicators for 2006 DOI are as follows.

- Indicators that provide an *opportunity* for the country's citizen to use ICTs:
  - Percentage of population covered by mobile cellular telephony,
  - Internet access tariffs as a percentage of per capita income,
  - Mobile cellular tariffs as a percentage of per capita income.
- Indicators that represent the *infrastructure* needed by any country to use ICTs:
  - Proportion of households with a fixed line telephone,
  - Proportion of households with a computer,
  - Proportion of households with Internet access at home,
  - Mobile cellular subscribers per 100 inhabitants,
  - Mobile Internet subscribers per 100 inhabitants.
- Indicators show the extent of ICTs *utilization* within the country:
  - Proportion of individuals that used the Internet,
  - Ratio of fixed broadband subscribers to total Internet subscribers,
  - Ratio of mobile broadband subscribers to total mobile subscribers.

The documentation around the DOI also continually stresses that this selection of indicators is 'internationally agreed upon', arising from consultation and deliberation with multiple stakeholders (WISR 2007). However, one might be tempted to see it more like a hotchpotch of measures that will often overlap and confound each other. Rather than being driven by theory on what constitutes 'digital opportunity' it is arguable that expediency played the major part in what is included – it can only be an indicator if it can be easily measured across the world. As with many of these supposedly 'objective' and technical rankings of what are complex social phenomena, the old accounting adage should be born in mind, that 'they only value what is measurable instead of measuring what is valuable.'

The superficial orderly appearance of the resulting DOI classification with each country neatly assigned a single score and put into a class, of course, helps to deflect the many questions related to data validity and statistical robustness that could be asked of its construction. Furthermore, each of the eleven indicators going into the DOI is itself a complex statistic that requires careful scrutiny, particularly in terms of how the multiple base data sources are gathered by different countries. In the 2007 World Information Society Report a table sets out some of the underlying intricacy of what goes into each indicator; for example for the 'proportion of individuals that used the Internet' variable: "The base year is 2005. A growing number of countries have carried out surveys. In the absence of survey data, national estimates are used. If these are lacking, then estimates are derived from the number of subscribers" (WISR 2007, 55). There are 181 countries ranked in the DOI and one wonders how the validity of these variables stacks up across that sample size.

Given the potential influence of the DOI to act as universal benchmarking tool, it is not surprising that it has come in for methodological criticism, including what it chooses to measures and how it is put together, especially the weighting of indicators. In terms of the choice of what to measure Peña-López (2007) asks 'where are the people?' in the DOI with its focus on infrastructure potential above digital literacy (the capability to exploit opportunities); 91% of the DOI is effectively based on infrastructure. James (2008, 790-791) has argued that the choice of indicator types is ill-considered, meaning that the DOI rankings are "deeply flawed and potentially misleading because they confuse ends and means or inputs and outputs"; the result he goes onto argue "blurs rather than sharpens divergences between means and ends of progress towards the information society."

5.5 Deconstructing area-based mapping of Internet globalisation

The 'International Connectivity' maps enjoyed an influential position as 'immutable mobiles', securing particular connotative impressions of the geography of Internet globalisation in the 1990s through their superficially simple and clear visual narrative. It is apparent that the ITU's 'Digital Opportunity Index' maps are quite likely to take on this role over the coming years.

However, in several respects they are both problematic and partial representations of world-wide network diffusion. The surface 'truthfulness' and authority of this kind statistical mapping as comprehensible representations of social phenomena is open to question in terms of the efficacy of cartographic design and in terms of political critiques of the ways they shape perception in the service of particular interests and agendas (cf. Crampton 2003 & 2004; Monmonier 1996). Both the technical weaknesses and the ideological concerns in statistical mapping typically remain unacknowledged by the institutions publishing them, as such an admission, it is feared, would undermine cartography's authority in representing the world. The maps must be presented as 'matters of fact' that speak for themselves.

Many map readers approach statistical maps assuming them to be straightforward and essentially accurate geographical presentations of social reality. Yet, the degree of generalisation necessary for successful cartographic design means that social reality is inevitably simplified, often to a gross extent, in statistical mapping. This simplification is pronounced in the widely-used choropleth approach and it is all too easy to draw naive and unsound conclusions as to the actual spatial distribution of the phenomena being represented from an orderly-looking world map. Therefore, in critiquing the representational effectiveness of the 'International Connectivity' and DOI maps, I seek to highlight the practical and political degrees to which they grant partial views of Internet globalisation.

In this section I discuss the key methodological problems, common to all choropleth mapping, and draw out the resulting political implications relevant to the 'International Connectivity' and DOI maps. These problems concern: the choice of scale of presentation and the design of the zones for aggregation; the invisibility of small areas and the denial of temporality; the nature of the classification scheme applied to the zones, and the resulting issues of ecological fallacy and grouping bias.

5.5.1 Zoning scheme design

The size of the zones in choropleth maps has a direct impact on the level of generalisation of the social phenomena being mapped. Larger zones average over more people to give a much less detailed presentation of the population. The definition of the boundaries for areal zones can also have significant impacts on the nature of the representation; perhaps most evident in terms of gerrymandering possibilities in drawing up electoral constituencies (cf. Johnston 2002; Monmonier 2001). Often people producing choropleth maps - using secondary data from the census, for example - are constrained to use a predefined set of zones in which the data has been published. For many social phenomena this is problematic as the zone definitions are arbitrary, not having been drawn up to take account of the 'real' distribution of the social phenomena; as Crampton (2004, 47) puts it: "Where human life is lived continuously, the map (especially the choropleth) chops up and divides." The possible ways the 'chopping' can be done are manifold - as Openshaw (1984) and others have demonstrated under the rubric of modifiable area unit problems (MAUP) - it also ineluctably has political ramifications because they alter the denotative visual properties of the map in favour of certain interests. In essence, zoning decisions can work connotatively to increase the perception of social difference or help to mask the extent of inequalities.

In the case of the 'International Connectivity' and DOI maps, the zoning scheme is the national state, as defined by the international standard ISO3166. Clearly, this is the most obvious scheme for world-scale statistical mapping. Indeed, world maps using countries as graphical containers for statistical data are so common and conventional that they are easily perceived as the 'natural' way of seeing the world, especially in atlases[21]. Yet, at the world scale, how efficient, let alone 'accurate', is it to aggregate 6.4 billion people into 192 pre-given country units - units that have been drawn-up arbitrarily in many cases? Many national borders are maliciously arbitrary in relation to the underlying social reality (the infamous colonial 'cartographic' partitioning of Africa being the archetypal case). The result is a set of mapping units with a huge range in terms of land surface and population size. Countries as units of analysis and mapping are a highly political metageography (Lewis and Wigen 1997). The definition of countries as stable, unitary objects, as we see them neatly drawn on world maps, masks contentious processes of territorial formation and ongoing maintenance - including some of the most bitter, bloody contemporary conflicts (e.g., the Balkans, Israel-Palestine, Kashmir). Notwithstanding this, countries as units of analysis are undeniably *convenient* analogues because, firstly, of their engrained familiarity with map readers and, secondly, their effectiveness for delineating the distribution of nation-state power as it currently operates (which remains pivotal for understanding many global socio-economic processes). And, of course, cartographic knowledge has played, and continues to play, a significant role in the *creation* of the nation-states they supposedly only represent (see Anderson 1991; Biggs 1999; Vujakovic 1995 and 1999b).

The question then, is how effective and appropriate are countries as units of analysis for describing Internet globalisation? In many respects it seems illogical to create maps that demarcate the Internet into the arbitrary territorial jigsaw pieces of nation-states. After all, the network technologies of the Internet are

[21] Although, this dominance is being partially usurped by the growing use of 'earth from space' satellite imagery which often do not show nation states. This is exemplified by Google Earth which, in its default setting, presents a 'natural' looking world free of geopolitical boundaries.

creating new online space and virtual groups that, according to some commentators, subvert the primacy of nation states and their boundaries. Border lines are less meaningful in the era of the 'death of distance' (Cairncross 1997), so the argument goes[22]. The use of countries in mapping the Internet is not only idiosyncratic; it has the visual effect of granting undue territorial authority over the 'space of flows'. Choropleth mapping 'chops' up what should be viewed as a continuous network flows linking people together into rhizomatic structures that cut across political frontiers. "The tracing of political borders in these maps of putatively virtual domains", Harpold (1999, 15, original emphasis) argues, "naturalizes specific relations between nation-state and network identities -- and, as a result, *obscures the global political forms of the Internet with a mosaic of individual national forms.*" These maps, like much of statistical cartography, work to constrain the inherent disorderliness of the social worlds and reinforcing uniformity of the status quo. As such, their connotations of little difference and low complexity mean they are positioned in the convergent quadrant in the fourfold conception (Figure 5.2 above)

Despite disputing the 'end of geography' thesis, I would nonetheless agree with Harpold that there is a *need* to loosen the metageographical shackles of the nation-state as a unit of analysis in the Internet and try to show some of the more local, contingent forces that affect the patterning of digital access and use by different people. Concurring with Harpold (1999, 18), I would argue that progressive analysis of the Internet "must look beyond the limited (and limiting) visual vocabularies of national-political identity, and base its investigations on new schemes for representing the archipelagic landscapes of the emerging political and technological world orders". Some interesting points of exploration in terms of cartographic design include the use of dot mapping showing the distribution of data at sub-national level, a chorochromatic thematic map which at world scale would represented data without boundaries (see Figure 5.19 below for partial

[22] This rhetoric proclaiming the decline of nation state power, in face of technological change, can be traced back, at least, to the telegraph era and the utopian hopes spurred by wiring continents with undersea cables (cf. Standage 1998).

example of this), and also flow mapping that represents data as point-to-point transfers (as done by Board *et al.* (1970) for South African telecommunications flows, see Figure 3.3 in chapter three). The pragmatics of making such alternative representations for the whole world are significant, as the necessary data are simply not available at this scale.

The counter-argument is that the notion of the fading away of nation-state power has been overplayed in much of the globalisation talk on deterritorialisation. The transcendence rhetoric surrounding telecommunications and computer networking, especially redolent in the 'dotcom' boom in the late 1990s, has been exposed as essentially hollow. The nation-state has been, and will likely remain, crucially important in the determination of people's actual experience of the Internet (setting legal parameters, regulatory structures, taxation, censorship, and so on; see Everard 2000; Jordan 1999, for cogent analysis). Most of the Internet, in terms of transmission infrastructures as well as content and services, is produced by large companies, and as Morgan (2004, 14) tellingly notes: "Contrary to fashionable notions of 'techno-globalism' and 'borderless worlds' the national environment remains a highly significant operating milieu for firms, even for so-called multinational firms." Moreover, many global firms are beneficiaries (and thus supporters) of current nation state based metageography of consumer modernity - for example, exploiting differential regulatory systems in production and segmenting markets in profitable ways. Consequently, it can be argued that, in many respects, the most *appropriate* way to analyse and visualise the global geography of connectivity is in the form of country-based units, as Landweber did through the start of the 1990s and that the ITU continues to do for 'digital opportunity' today.

In many respects, Landweber's and ITU's choice of units of analysis was down to map-making expediency; as Vujakovic (1999a) notes, in relation to maps produced in the news media, one should be alert to the dangers of looking for 'hidden agendas' for what are in actuality pragmatic decisions made under resource and time constraints. Moreover, in terms of the practicability of the 'International Connectivity' and DOI maps, country boundaries are undoubtedly convenient for many readers because they render abstract notions of 'internet' and 'information society' into easily understandable visual forms (at least for majority who are acquainted with the cartographic conventions of thematic maps). This factor above all was particularly important at the beginning of the 1990s when the prospect of global networking was strange and unfamiliar to most people and, arguably, remains so for institutions like the ITU that seek to influence mainstream discourses around appropriate development policies that require conventional representations.

5.5.2 Hiding small places and silencing temporal variability

The use of a map projection based on geographic area to represent statistical data at the global scale inevitably creates a distortion that visually favours territorially large countries and renders small, but populous, nations effectively invisible. Much of the 'data-ink' on statistical maps is, therefore, wasted in showing land where few people live. This technical weakness has obvious political repercussions in trying to understand the social processes taking place. This problem is a taken-for-granted, largely irresolvable artefact of world scale mapping and usually ignored. However, it has been purposefully highlighted by a number of socially-conscious cartographers and geographers, leading some to advocate counter-mappings based on cartograms (e.g., Dorling 1998; Vujakovic 1989; see section 5.7 below for further discussion and analysis of several apposite examples). On the 'International Connectivity' world maps, a number of countries are simply not drawn at the given scale and pixel resolution of the image. Many islands are indiscernible, including much of the Caribbean. A number of city-states, including the Asian technology 'hotspots' Hong Kong and Singapore, have such small geographic footprints that they do a cartographic 'disappearing trick'. Yet, these places are not unimportant in understanding Internet globalisation - several Caribbean nations, for example, have become important nodes in e-commerce and online gambling because of their offshore status (see Wilson 2003). This is ironic, as many of these nations are consciously trying to exploit the Internet to project a global image and overcome the inherent limits due to their small territorial size (see Brunn and Cottle 1997). The result, then, is a capricious map of Internet globalisation that excludes significant countries from consideration on the sole criterion of their land surface.

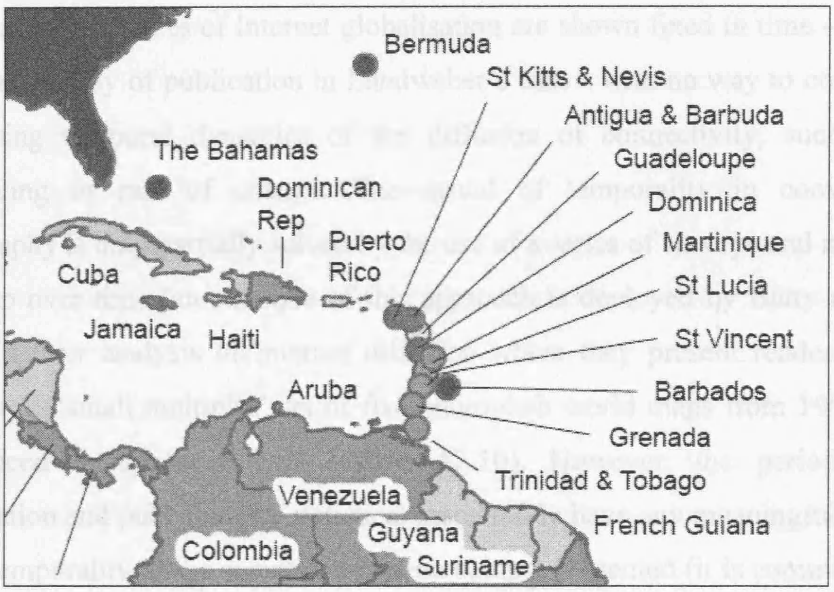

Figure 5.11: A subset image of the Americas regional DOI 2006 map showing the use of circle symbols as artificial graphic enhancement for small nations. (Source: author screenshot from original map, WISR 2007, 158.)

The DOI maps perform somewhat better than the 'International Connectivity' maps in representing nations with small territorial extents. This is achieved, in part, technically through the media of map distribution (vector graphics in PDF allow readers to zoom to see greater detail) and through the application of design device of circle symbols as surrogates for otherwise invisible countries (Figure 5.11). These circles are relatively effective denotatively but inelegant connotatively as it tends to mark out these place as somehow unusual. Furthermore, the provision of regional breakdowns (for Africa, Americas, Asia-Pacific, Europe) in the WSIS report and on the DOI website allows for larger maps that show more detail (these maps are also labelled to highlight countries, as can also be seen in Figure 5.11). More radical alternative methods of displaying classified data that denote small areas are possible, such as projecting the data into three-dimensions (an example of which is examined below, see section 5.6.1) but these are often unsatisfactory compromises.

Statistical maps like the 'International Connectivity' and DOI examples also necessarily distort dynamic processes by arbitrarily freezing them at a *single* point in time. The processes of Internet globalisation are shown fixed in time - credited to the actual day of publication in Landweber's case - with no way to convey the underlying temporal dynamics of the diffusion of connectivity, such as the sequencing or rate of change. The denial of temporality in conventional cartography is only partially solved by the use of a series of surveys and maps that build up over time (an example of this approach is deployed by Batty and Barr 1994, in their analysis of Internet diffusion where they present readers with a Tufte-style 'small multiples' set of five choropleth world maps from 1991-1994; reproduced in appendix two, Figure A2.10). However, the periodicity of compilation and publishing of statistical maps rarely have any meaningful relation to the temporality of the social phenomena being represented (it is commonly just a function of administrative convenience, e.g., the decennial cycle of censuses). Consequently, the handling of the temporality of events in thematic cartography remains a largely unresolved problem[23]. Even animation and interactively offered, for example, via online mapping toolboxes like GapMinder (<www.gapminder.org>) can not overcome the episodic nature of the collection and publication of most global scale socio-economic datasets This failure has ideological implications, as the inability to represent dynamic phenomena over space *and* through time means much of the subtlety of social life is simply unmappable (Dorling 1998).

5.5.3 Implications of classification

The final - and most significant - methodological problem with statistical maps concerns the process of data classification. The selection of the number of classes, and their intervals, for grouping data on choropleth maps is crucially important in denotative term to the appearance of spatial patterns and, thus, the connotative

[23] Developments in map animation and multimedia, and more recently in geovisualisation environments, are opening up interactive avenues for mapping phenomena spatio-temporally (see Cartwright *et al.* 1999; Harrower and Fabrikant 2008; MacEachren and Kraak 2001), but have not yet delivered any generally applicable solutions.

impressions that readers receive on the phenomena being represented. Producing practicable and meaningful classifications is a real challenge, as a balance must be struck each time a choropleth map is made, since, "[r]educing the number of classes achieves simplification at the expense of loss of useful detail, especially local contrasts" (Evans 1977, 99). In the days of manual cartography, cartographers typically used a small number of classes as a matter of convenience rather than because of any deeper philosophical or perceptual concerns. In recent decades, there has been considerable investigation by cartographic scholars into the specification of 'optimal' classification schemes from both the statistical point of view (e.g., Jenks and Caspall 1971; Evans 1977) and from the perspectives of aesthetics and map usability (e.g., MacEachren 1982; Slocum and Egbert 1993). Computer mapping and GIS has made it much easier to experiment with different classification schemes for a given data set, but have given little help to users in choosing a workable one; and Jenks and Caspall's (1971, 221) perceptive comment still holds true: "[w]e are certain, however, that many maps result from an almost accidental setting of class limits". This is significant because the use of an inappropriate classification scheme can, at a stroke, render a choropleth map unworkable.

However, beyond technical concerns on performance, it is clear that the nature of the classification scheme in statistical mapping has political ramifications because of the connotations that readers may draw about the underlying social reality denotatively being 'accurately' represented. The design of the classification, either deliberately or unintentionally, serves a purpose in highlighting the 'right' spatial pattern for the map-maker's agenda. Active manipulation of classifications, as Monmonier (1996) has demonstrated, opens up a rich array of ways to 'lie with maps'.

The level of simplification implied in fourfold classification on the 'International Connectivity' maps, for example, as it is applied to the complexity of world-wide patterns of Internet diffusion, is problematic. The distinction between the four classes in the map is important, and corresponds roughly to the increasing sophistication of services possible, the persistence of the connection, the bandwidth of links, and also the likely cost. Only full internet connectivity allowed interactive services, including telnet and ftp, that require persistent synchronous links. In a sense, the middle two classes are intermediary levels of sophistication in terms of possible services. 'Bitnet' and 'EMail only' connectivity only supported asynchronous interaction and did not provide persistent connectivity. 'Bitnet' was a formally constituted network, with fulltime operational managers and users had to pay for access[24] (cf. Kellerman 1986). In contrast, the 'EMail only' type networks of Fidonet and UUCP[25] were informal (low cost/no cost) networks relying on volunteers to operate nodes for 'store and forward' email transmission (cf. Bush 1993). (The issue of classificatory collapse of reality, is even more problematic on the adapted version of the 'International Connectivity' map used in Castells' book (Figure 5.7 above) conflates the middle two classes into one.) The bottom class of 'No Connectivity' seems quite straightforward, although this will also have included 'no data' countries - the maxim, 'absence of evidence is not evidence of absence', always needs to be borne in mind when reading statistical maps. (This issue reappears in a similar vein with the ambiguous classificatory status of the 'rogue states' of Afghanistan, Iraq, North Korea and Somalia in the DOI map.)

The DOI is a much more sophisticated measurement of 'reality' and has categories (and the bar chart under the map allows alert readers to see the distribution of countries in the classes). Yet there are deeper conceptual problems with the DOI and similar kinds of indexes. One can argue that they are less meaningful, in important commonsense terms, than simple measures because their classification have no direct, intuitive relation to the real-world they purport to represent. (In this sense the four levels of the 'International Connectivity', whilst a gross simplification, are at least more intuitively meaningful than the DOI.) The composite nature of the DOI, made up of eleven different indicators, means that

[24] Bitnet had 'gateway' connections to the Internet to enable exchange of email. However, it was distinct from the Internet as it did not use the TCP/IP protocol for data transmission.

[25] For half of the maps - versions 6 to 11 - the '`EMail Only`' category was expanded to encompass OSI networks in addition to UUCP and Fidonet. Reproduced in appendix two, Figure A2.2. See Salus 1995 for discussion of significance of the OSI challenge to TCP/IP in the early 1990s.

overall score for each country does not stand for anything specific or tangible, it is just a number representing 'digital opportunity'. Yet no one know what this is, as it does not exist – it is a statistical construct. Furthermore, this DOI construct is literally 'made-up' and varies from place to place, so a similar DOI score in two countries does not mean they have comparable social and technological characteristics. This is counter intuitive in many respects. The classification of DOI into ten equal classes also has no inherent real-world meaning (what is the *real* difference between a score in the range of 0.4-0.5 and one in 0.5-0.6?). In this fashion, the DOI is a statistical 'black-box', which readers must take on faith to it represents some aspect of reality. However, in important ways, I would argue, the map has no relation to the world it represents, it merely reifies the DOI score as a reality. Much the same kinds of criticism were levelled at sophisticated factor analysis in the 1970s that produced statistical values that were not intuitively meaningfully to social experience; and some argue this applies today with evermore sophisticated deprivation models and geodemographic profiles (cf. Burrows and Gane 2006; Curry 1997).

Additionally, the process of data classification in statistical mapping usually implies, either explicitly or implicitly, a ranking of areas. When people are being represented on maps, the visual ranking has social meanings, with the map-maker exercising disciplinary power to produce an ordering of areas (and thus people) from 'good' to 'bad' or sorting out the 'successful' from the 'failures', according to particular criteria. Depending on the interests served, statistical maps can be deployed as instrumental tools of discrimination, operating as elements in larger systems of modern governmentality (Harley 1988a; Crampton 2004); for example in much 'top-down' analysis of poverty, choropleth type maps are used as a visual instrument for identifying areas suffering 'problems' - and implicitly the 'problem' people who need help - and enabling the spatial targeting of 'solutions' (cf. Yapa 1992). The judicious manipulation of data classification means it is possible to produce the 'right' ranking to identify the desired type of areas (and people) to target. The issue of power over people created through social order and instrumental targeting is at the heart of 'Ground Truth' critique of GIS and geodemographics (Curry 1997; Goss 1995; Pickles 1995).

In the cases of the 'International Connectivity' and DOI maps, the ranking serves the purpose of expounding a normative ranking of technological prowess. It has an explicit political ordering of countries based on their 'worth' to the so-called information society. For the 'International Connectivity' maps it runs from *Good* ('Internet') to *Getting there* ('Bitnet but not Internet') to *Unacceptable* ('EMail only') and bottom of the list, are the *Failures* ('No Connectivity). This last group of excluded nations are ripe for 'targeting' with (Western) networking know-how to 'solve' *their* problem of underdevelopment. With the DOI map countries become progressive more 'healthier' coloured, connotatively, the higher you climb up the 'ladder of progress' to the ideal state 1.0, complete 'digital opportunity'. Most of the rich world is already comfortably ('naturally') classed atop the 'International Connectivity' ranking and 'in the pink' with a high DOI score, and with each passing map, it is possible to see how well the other straggling nations are doing to 'improve themselves' and climb their way up the list. Such quantifying and ranking approaches can be seen as indicative of developmentalist view of inequality that locates the 'problem' solely within the boundary of the impoverished countries and exhorts them to follow set pathway out of poverty. For example, Yapa (1992, 507) in his critique of the pernicious use of maps of GNP as unproblematic 'facts' about the worldwide distribution of poverty notes: "[w]hat do we really communicate when we use this map?: that it is reasonable to compare whole nations to each other according to the exchange value of commodities; that developed countries are advanced because they have a higher GNP per capita; that underdeveloped countries need to expand their GNP rapidly if they hope to solve the problems of hunger and poverty, and catch up with the rest of the advanced world. But growth in GNP has no necessary relation to the eradication of hunger."

The connotative impact of the ranking of areas is frequently enhanced on choropleth mapping through the particular choice of colours and shadings and their sequence. Understanding colour perception related to the visual classification of areas on choropleth maps combine aspects of psychological comprehension, physiological processing and subjective interpretation in complex ways. The meanings taken up by readers are unstable and perhaps inconsistent (Dent 1995, 295). Although Keates (1996, 234) argues that colour in this context works in a "fundamentally metaphorical" way, where "fully saturated and dark is equivalent to either more of, or more important than; and less saturated and lighter is equivalent to either less of, or less important than." So where the choropleth map colours sequence run from dark to light colour, it can be argued, that the dark colours and heavy shadings reinforce notions that these are the 'darkest' areas, with shadowy people and endemic failure - what Cosgrove (2003, 134) calls "cartographic gloom" - while light colours give off the impression of progress, success and the 'light of reason'. Charles Booth's poverty map of London is a 'classic' in this regard. The streets at the bottom of his ranking, 'lowest class. vicious, semi-criminal', are shaded black, while the top category, the 'upper-middle and upper classes. wealthy', are coloured a light golden yellow.

It is interesting, however, that on the 'International Connectivity' and DOI maps the choice of colours are in reverse of this, with the darkest hues, being applied to the top category and the lightest colour to lowest category. The eight stage colour ramp on the DOI map, in particular, is open to connotative interpretation running as it does from light beige up to dark purple. One could argue that the saturated purple gives the impression of solidity, surety and, perhaps, superiority of Western Europe / North America in 'digital opportunity', in marked contrast to the pale and anaemic colours used to portray many nations at the bottom end of the ranking. Purple has historical connotations with royalty and richness (Dent 1995, 295). Many of these low scoring (under performing) countries lie in the global South, which in the Western imagination are stereotypically seen as poverty stricken places that are arid and dun-brown. In some senses, then, the DOI map resonates with Vujakovic's (2002b, 372) observation that the choice of colour can often "play on culturally embedded connotations; for instance, maps of the British empire were traditionally coloured pale red/pink, with connotations of 'health/vigour'."

5.5.4 Ecological fallacy and grouping bias

In addition to the issue of ranking, there are two more fundamental problems associated with the imposition of a constricting classification scheme on data in choropleth mapping. While classification is useful (often vital) to denote complex patterns of variability in a clearer fashion, and thus more easily comprehended, it also induces the problems of grouping bias and ecological fallacy. These are visual-cognitive effects on the map reader which work to diminish the apparent difference *between* areas and overstate the level of homogeneity *within* areas. These problems are not tractable from a map efficiency point of view, but must be embraced to begin to comprehend the ideological implications of statistical mapping. The later 'International Connectivity' maps and DOI map are an apposite example of both problems and create convergent connotations by reducing the apparent complexity of the pattern of Internet globalisation and the extent to which difference between nations is visible.

The ecological fallacy as a general statistical problem occurs when a relationship observed at one scale of aggregation is assumed to hold true when looking at a more detailed scale, without proof or testing. More specifically, in the case of statistical maps of social phenomena, it is the 'natural' tendency, in graphical connotations, to assume that the residents in an area *match* the average conditions of the area as indicated through the uniform shading on the map. This notion is commonly expounded in media reporting on social issues such as crime, health, and education (cf. Vujakovic 1998). This is problematic when demeaning social stereotyping based on the area's characteristics come to taint individual lives.

In the case of the 'International Connectivity' and DOI maps, each country is assigned to one class and wholly shaded accordingly. The result is an easily-conferred visual impression that every location within the country has equivalent levels of network connectivity or digital opportunity and all citizens enjoy comparable access, which is clearly not the case. Uniformity in the shading of spaces on the map is all too easily connoted into uniformity of places on the ground[26]. Therefore, the ideology of ecological fallacy in these maps instinctively promotes an artificial sense of homogeneity, masking socially-significant variation and inequality within countries. This denial of differences in terms of reader connotations, one might argue, serves the interests of diffusionists because the results is a more orderly and convergent representation of social reality.

The reality of network access is far from uniform, particularly so in the early 1990s as many empirical studies have demonstrated (e.g., Miller and Slater 2000; Press 2000; Warf 2001). The effect of the ecological fallacy in the 'International Connectivity' and DOI maps are most evident, and significant, in the poorest places. In many least developed countries (LDCs), international network connectivity, especially in the early 1990s when Landweber created his maps, was likely to be very restricted, available only at certain elite institutions in primary urban centres. As Holderness (1998, 40) pointedly comments: "[t]here may be a full Internet connection at the university in Ulan Bator, but ten kilometres away there are no telephones." Despite very rapid growth in mobile phone use, significant basic access inequality issues remain in many LDCs today, which Castells (1998, 82) memorably characterised for Africa as "technological apartheid".

The ecological fallacy also has insidious effects for rich nations, imposing unrealistic visual homogeneity. In well-'wired' nations, including the U.S. and Britain, there were significant variations in take-up at in different regions throughout the 1990s[27] (e.g., see NTIA 1995; Office of e-Envoy 2002), often the focus for 'digital divide' policy initiatives. Although these differences in basic Internet access have closed markedly since the last 'International Connectivity'

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[26] I would argue this is exacerbated because areal units in choropleth maps are drawn for simplicity, using a so-called 'space-filling' approach - that is, no part of the territory can be left blank as unclassified. This contrasts with dasymetric approaches, described in section 5.6.3 below, which fades sparsely populated regions and greys out uninhabited area. Although, it acknowledged that the dasymetric is not a panacea for all problems of ecological fallacy; they are still scale dependent, so on world maps do not distinguish at the local level (Vujakovic, notes on thesis draft, October 2006).

[27] There are, of course, also inequalities along other important social dimensions such as age, gender, class and race (cf. Shade 2003; Warf 2001).

map was drawn in 1997, socio-spatial differentials in networking capability are being replicated, in a quite similar fashion to the early 1990s, with the deployment of newer (faster, and more flexible) technologies like fibre-to-the-home and municipal public wi-fi coverage (Townsend 2003). So 'digital opportunities' are not evenly distributed, socially or geographically, with in developed nations but the connotation arising from ecological bias is that everywhere is uniformly 'in the pink'.

Due to the nature of the choropleth mapping, with its inherent visual dominance by geographically extensive areas, the ecological fallacy also contains an in-built rural-urban bias. As the average rate, determined predominantly by densely populated urban areas, must be 'painted' across the whole country, this can mean a significant overestimate of networking potential of rural areas. This is certainly the case with the 'International Connectivity' maps (extreme cases, in Figure 5.4, being Russia, Canada and Australia). Whilst network access has diffused to many rural areas over the last decade, the economic reality is that Internet *production*, despite the 'spaceless' rhetoric, is to a large extent an urban phenomenon, dominated by hubs in a few large cities[28]. Is it likely that 'digital opportunity' is the same across the whole of Brazil or China as it connotes to be or concentrated in a few major cities, mostly along the coast.

The second cartographic 'error', with political ramifications, caused by classification in statistical mapping is grouping bias, which is the prejudicial contraction of the differences *between* units of enumeration. Because of the limited number of categories, coupled to the selection of their class limits, it is often the case that really quite dissimilar countries end up being assigned, and visually labelled, to the same group. In conventional choropleth maps there is no scope for ambiguity or fuzziness, each zone must be classified completely - it can only exist in a single group. In the case of the 'International Connectivity' maps,

[28] According to Zook's (2005) empirical analysis of January 2002 data, the top 100 cities across the world, with only six percent of the global population, contained fifty percent of the Internet domain names.

all the diverse countries of the world have to fit into just four groups. The lack of discrimination in the top Internet class is especially problematic. Only a minority of countries shaded Internet purple actually had comparable nation-wide infrastructures to support genuinely comprehensive network access, especially so in the first 'International Connectivity' map from 1991 (Figure 5.4 above). The amount of international network connectivity could vary from a single (expensive, low bandwidth) satellite link in the capital city along a spectrum of capacity, up to countries with dense networks of high-capacity fibre-optic cables linking many parts of the country to the Internet. For example, on the 1991 map, the three nations that constitute North America are all shaded purple, denoting they are in the same group because they all have Internet connectivity, yet it is an inappropriate connotation if readers believe that Mexico's Internet capability was in any way equivalent to that in the USA and Canada at that time.

In the final 'International Connectivity' map produced by Landweber in June, 1997, a large proportion of the nations are classified as having full Internet connectivity. "Almost the whole world, it seems from a casual inspection of this map, has turned Internet-coloured" Holderness (1998, 39) sardonically commented[29]. Yet, this connotation of Internet hegemony through graphic homogeneity is map fiction. Despite their belonging to the same category, Petrazzini and Kibati (1999) demonstrate that the USA, Argentina and Kenya, for example, have fundamentally different Internet statuses, noting that end-user access costs (adjusted for purchasing power) were nine-times higher in Argentina than the U.S., and 413 times more expensive in Kenya. It is not just in the consumption of the Internet that inequalities are masked: arguably even wider and politically more significant variations are hidden in terms of Internet production (again, demonstrated by Zook's (2005) analysis of the geography of the Internet industry). The result, then, for an unwary reader of the 'International Connectivity' maps, is that countries coloured the same are easily assumed to

[29] Interestingly, he went on to construct his own version of the 'International Connectivity' map, which tried to remove some of the grossest distortions of the ecological fallacy and grouping bias, effectively by using dasymetric mapping techniques (discussed in section 5.6.3 below).

have equivalent levels of connectivity in reality. Reducing the connotations of difference between neighbours and across continents is powerfully convergent.

Grouping bias still applies for the DOI map as 181 different countries must be grouped into eight classes[30]. Although the extent of grouping bias is lessened somewhat as there are twice as many categories than in the 'International Connectivity' maps and the ranking of countries by their DOI score on the bar chart under the maps provides useful information on the class distribution and the degree of variance in their score. A much more radical representational strategy to overcome grouping bias would be classless choropleth techniques (cf. Peterson 1979; Tobler 1973), where all countries are uniquely shaded. Such mapping is now easily produce by mapping software and studies show readers can interpret them, but not widely seen as too unconventional and the resultant patterns are too complex.

In combination, then, the ecological fallacy and grouping bias result in the graphical imposition of homogeneity, diminishing diversity and the erosion of difference between places. The deeper question, then, is who benefits from the cartographic concealment of true inequality in the distribution of networking across the world in the 1990s? Making the situation *look* much better than the underlying social reality supports the 'diffusionist' viewpoint.

5.6 Design extensions to area-based mapping of Internet globalisation

There are various design options that can be applied to represent area-based statistical data to overcome some the methodological issues with conventional choropleth maps. While these can generate different denotative meanings about statistics of Internet globalisation, it is not always so easy to change the connotative impressions of the mapped world. In this section consideration is given to three extensions that have been used to represent Internet globalisation differently from standard choropleth mapping: pseudo three-dimensional stepped surface mapping, hybrid diagram mapping, and, lastly, dasymetric mapping.

[30] Plus the two special classes for 'no data' and for the 'rogue states'.

5.6.1 Stepped surface mapping of Internet globalisation

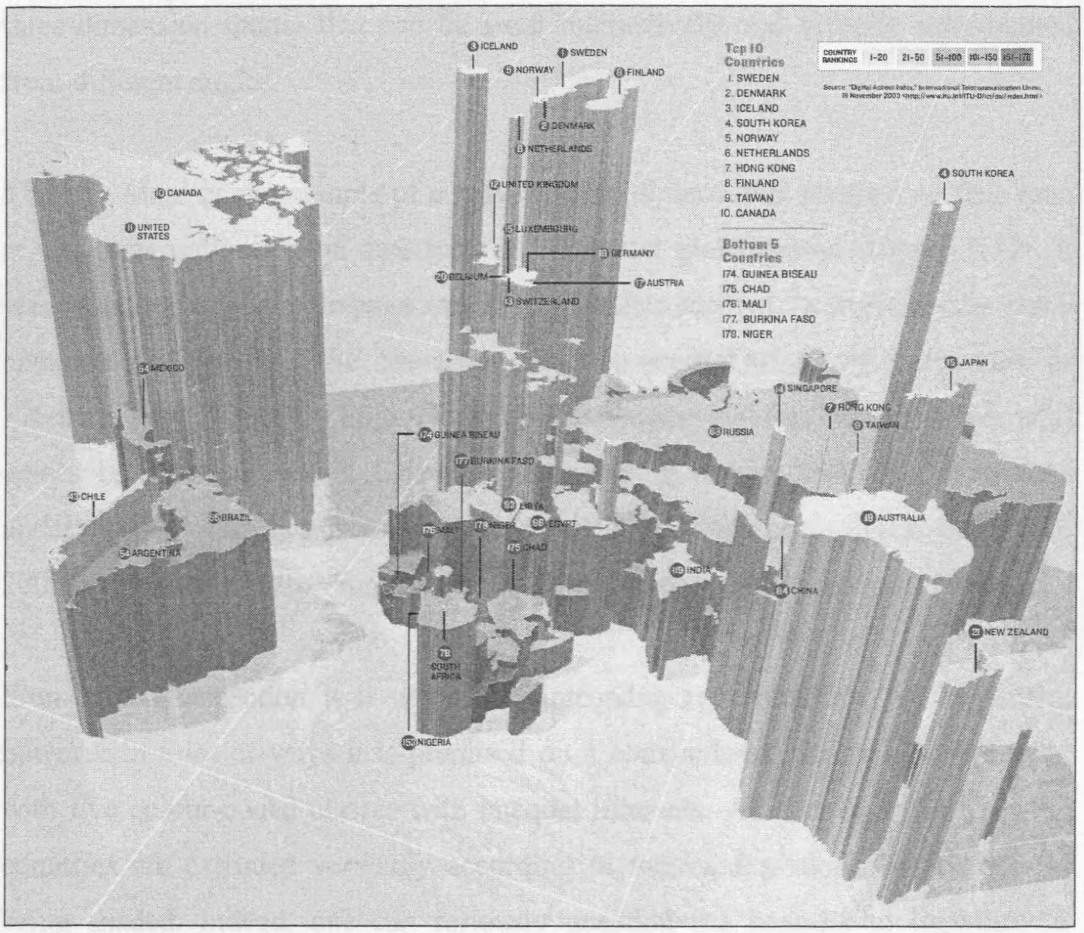


Figure 5.12: The 'Bit Map', a pseudo three-dimensional stepped surface map representation of the ITU's Digital Access Index. (Source: Cherry 2004, 54-55.)

Projecting data into the space above the x-y plane of conventional cartography is one possible way to display more levels of attribute information in statistical maps. The use of the z-dimension for representing density values and trend surfaces is relatively common and now quite easily generated with GIS software from point sample data. It is also possible to represent area-based data volumetrically as a stepped surface map where height above the ground of each enumeration unit denotes a statistical aspect of the data. Such stepped surface maps have some novelty as 'alternative' representations and do offer the potential to display more of the variance within data than may be possible with shading of the enumeration units according to a limited classification (i.e., z-dimension is unclassified). However, they also suffer from problems of visual occlusion when presented statically on a flat sheet of paper or display screen, rather than as a fully three-dimension model that can be used interactively and visually interrogated from different angles.

The 'Bit Map' is an example of a pseudo three-dimensional stepped surface map representing national-level data related to Internet globalisation (Figure 5.12). It was published on a double-page spread in an article entitled, 'a world divided by a common Internet' in *IEEE Spectrum* (flagship journal of the U.S. Institute of Electrical and Electronic Engineers). The accompanying text claims it "show[s] who's bit-rich and who's bit-poor, and why" (Cherry 2004, 56). The data underlying the map was from an ITU calculated 'digital access index' created in 2003, and a statistical forerunner to their DOI national ranking discussed above.

From initial inspection it is a visually intriguing representation of the world, however in a lot of ways it is premised on a conventional choropleth approach, with five colour-coded classes with unequal intervals. All that is different is the countries are extruded vertically according to their index score, in addition to being shaded. Indeed, one can seriously question the benefits to legibility in employing the stepped surface mapping technique as the scaling factor for the extrusion means particularly tall counties mask other parts of the map. The vertical bulk of Australia blocks out much of Southeast Asia, for example, and the relatively well-wired South Africa obscures a good portion of central Africa. In denotative terms it is also difficult to compare reliably the heights of countries from different regions (is Brazil higher than South Africa?). Given the viewing angle for map, some countries also have an unfamiliar shape to them making identification more difficult. The one noticeable benefit of projecting up off the surface of the map is that territorially small nations that score highly – and therefore stand tallest – can be much more easily discerned than on a 'flat' choropleth map (e.g., Hong Kong, Singapore).

Besides the denotative issues with information legibility, the 'Bit Map' does, however, connote powerfully an *overall* sense of the patterns of sharp divisions across the world. The countries in the global North metaphorically and graphically appears to stand over the world and dominate the map. This is enhanced for some countries because of the viewing angle at which the map is drawn. The overall tilting of the map diminishes the apparent size of the nations in the southern hemisphere. The bottom scoring - denotatively lower - countries are all found across the middle of the continent of Africa. Statistical 'cliffs' seem to rear up to separate the 'mountainous' networked core of Europe from the flat under-wired periphery. Inequalities between some neighbouring countries appear to be sheer and physically insurmountable because of how they are drawn, quite a different connotation in comparison to how disparity between classes in a 'flat' choropleth map is read. In connotative terms the difference between high and low have clear social significance to readers, creating valuative connotations; Harpold (1999, 17) observed of such three-dimensional statistical mapping: "[a]cross its peaks and valleys emerges an archipelagic, virtual landmass that traverses the conventional boundaries of continents and nations. Viewed from on high, the vast, flat surface of the network's digital plains seem far removed, alien and obscure."

Geographically contiguous nations at the same level of distribution tend to merge into one another, supporting the impression of large politically unmarked terrains free of significant activity at lower level, and others, politically-differentiated but also uniformly towering over the rest of the world. (The towering nations are all signalled as important connotatively by the selective denotative labelling.) Yet, it is not just about height alone, the use of the z-dimension creates much greater visual differences, enhancing the presence of already territorially large countries that score well, by granting them voluminous amounts of space on the map display (e.g. Australia, the U.S./Canada are not just taller, they appear to be very much bigger than other nations). Along with the effect of the bright yellow colour, for the countries in the top category, the connotative meaning of their bulk is clear - bigger is better.

The selective labelling strategy highlights that this is not a map of the whole world as it purports to be, but actually a map of an American viewpoint on parts of the world that are deemed to be significant. (The top 10 countries are listed against only the bottom 5, for example) Many nations outside the core economies are left unmarked; the 'middle' ranked countries, of average height, are undifferentiated and unnamed. Special treatment is reserved for the bottom five countries in central Africa which are purposefully identified by text even though they barely register as volumes in space.

The selective labelling, combined with the widely differentiated heights applied across the world (rather than classifying the z-values) means that the patterns revealed are too complex and disorderly to connote convergence. And despite the muted colour ramp that hints at convergence, the connotative effects of such uneven heights and variations in volumes between adjacent nations and across continents is to imply an excess of difference in the world. As such the 'Bit Map' is firmly located in the divergent quadrant of the fourfold conceptual model of connotative meanings.

The 'Bit Map' read semiotically in its totality is also clearly projecting a forcefully valuative connotation, it is "intended to aid in preferential selection" (MacEachren 1995, 227). A more challenging way to re-map the 'world divided by a common Internet' would be to reverse the logic of the extrusion so the lower the statistical score, the taller the projection of the country. This would, perhaps, contest stereotypes by highlighting the divergent of the world seen from the perspective of those nations usually at the bottom of worldwide ranking schemes.

5.6.2 Hybrid diagram mapping of Internet globalisation

Another thematic mapping method to display statistical data is using multiple small charts or diagrams drawn within country boundaries. The advantage is that the diagrams can display several different statistical values at the same time rather than the single value denoted through shading the enumeration unit. The notion is that the reader can make comparative inferences between areas according to multiple statistical dimensions, giving a more nuanced understand of the spatial distribution and the underlying social processes. Although the results are not necessarily effective because, as Board and Taylor 1977 31) note, attempts "to show both the total volume and proportional sub-divisions of a phenomenon in an area by complex symbols such as pie-charts sets up mutual interference or ‘visual jamming’ that could be severe enough to reduce the information communicated by both sets of information.”

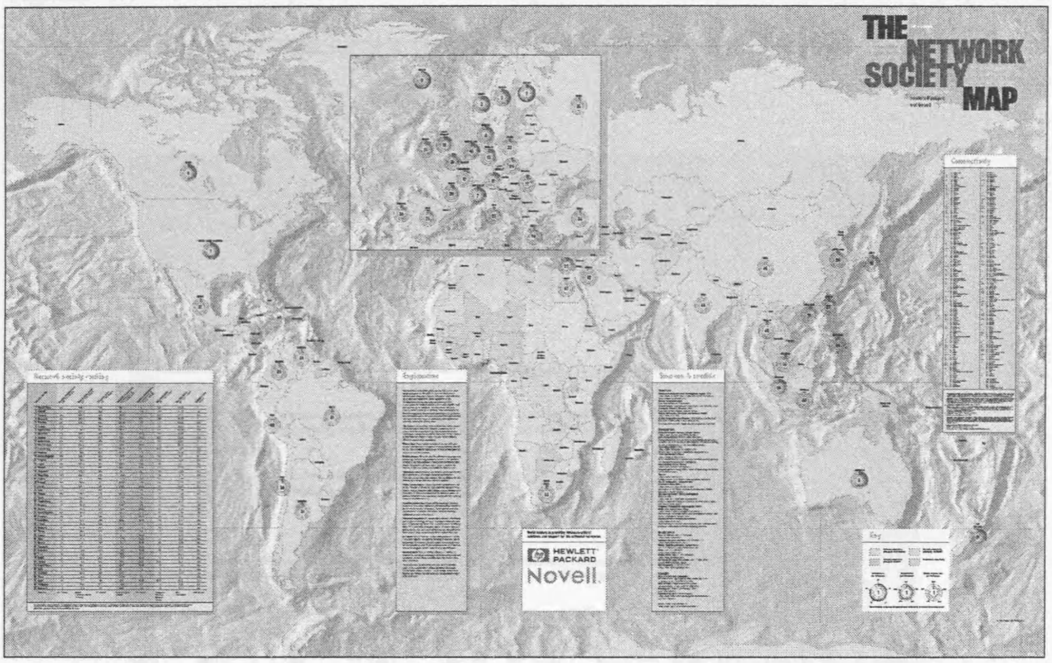


Figure 5.13: The ‘Network Society Map’, published by World Link, 1997. Map research and conception by Nico Macdonald; cartography by Chapman Bounford. (Source: Spy Graphics, <www.spy.co.uk/research/worldlink/>.)

An example of diagram mapping applied to the theme of Internet globalisation is the ‘Network Society Map’[31], published in 1997 by World Link magazine (Figure 5.13; a larger version is also reproduced in appendix two, Figure A2.11.) The ‘Network Society Map’ was originally designed to be distributed as a large poster (measuring 32" x 54") for “the occasion of the 1997 Annual Meeting of the World Economic Forum in Davos, Switzerland”, according to subtitle. The overt business-focus of the map is denoted explicitly in the text in the ‘explanation’ box, the being to “show how well prepared 49 of the largest and most dynamic

[31] Another conceptually similar but graphically more complex diagram map entitled ‘Wired Countries of the World’ was produced in 2007 by the World Information Access Project. It is not analysed here as it does not add anything substantive to the arguments but is reproduced for information in appendix two, Figure A2.12. This map suffers severely from what Board and Taylor (1977) term ‘visual jamming’.

economies are to compete in the network society." The map's support for global capital is reinforced through its visible sponsorship by Hewlett Packard and Novell, two major multinational IT companies with the prominent presence of their logos in middle of the page. The connotations from these texts and logos signals the world as represented in the map is ripe for capitalist exploitation, it is a dehumanised view of national markets with differing opportunities for investment and profits.

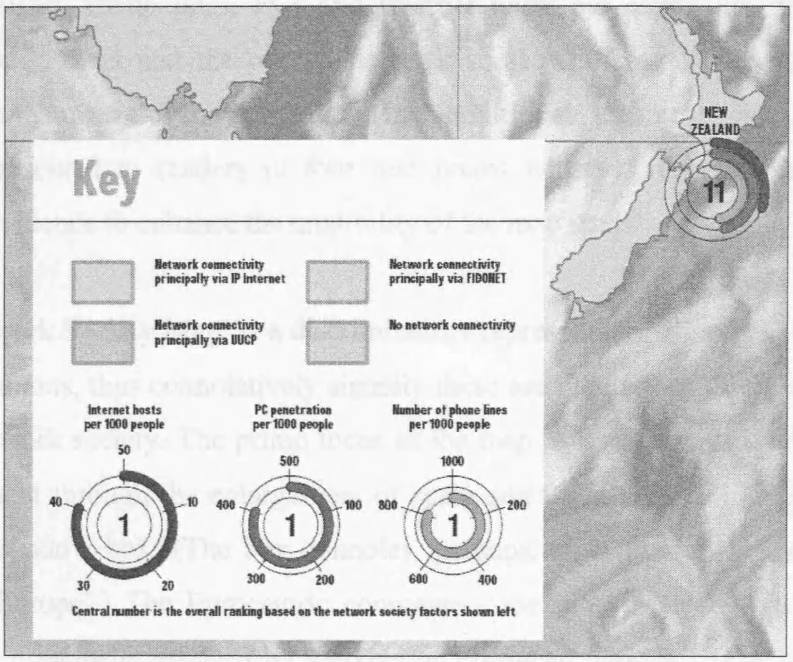


Figure 5.14: A subset image of the 'Network Society Map' showing the key showing the choropleth shading scheme and doughnut symbol. (Source: author scan from original.)

The map is well constructed cartographically with has production values as befitting its target audience; it is rather more aesthetic than purely scientific. For example, the design uses a graticule and shaded ocean floor terrain to frame the countries which creates a more realistic feel to the background, rather than the unadorned white frame more typical of statistical maps. All countries are identified and have name labels.

The map visually denotes five different statistical variables (see legend detail in Figure 5.14), although it is demanding to make meaningful comparative inferences between them and across multiple countries. At the base level, all counties are assigned into one of four classes and shaded accordingly. This classification is actually Landweber's 1996 'International Connectivity' survey (acknowledged in the notes at the bottom of the Connectivity text box). Most of the world is in the top class (full Internet connectivity) and shaded a warm pastel pink, except for the mosaic of colours across central and southern Africa indicating much greater difference. Doughnut-type symbols located within a select number of countries denote another four data variables (Figure 5.14). Three ICT measures, phone lines, PCs and Internet hosts per capita are denoted by colour coded rings and the overall network society ranking is denoted by the number at the centre of the doughnut. Much additional 'technical' data and detail is also presented to readers in four text boxes which work connotatively as credible evidence to enhance the credibility of the map itself.

The 'Network Society Map' is a discriminatory representation, denotative ranking only 49 nations, thus connotatively signally these are the nations that matter most in the network society. The prime focus of the map is Europe with its denotative enhancement through the enlargement of scale and the graphical highlighting in the drop shadow box. (The box connotes, perhaps, as a protective wall around 'fortress Europe'.) The Eurocentric connotative meaning is clear - the network society is principally enjoyed by markets of European nations[32]. The rest of the world is relatively sparely covered, except for a slight cluster in Southeast Asia economies; large swathes of the world and hundreds of millions of people are, by implication, excluded from the network society. The 'empty' African continent languishes, connotatively, below spatially enhanced and graphically enclosed Europe, only receiving doughnut symbols at the top and tail and nothing worthy of network society status in between. Indeed, much of the equatorial zone of the world seems to be beyond the network society with no doughnut symbols found in the Caribbean or Central America. The large expanse of Russia (heading east beyond the safe confines of the European citadel) and central Asia is also a

[32] Although even in the European heartland of the network society, there is powerful and judgemental selectivity on what nations matter. Many 'emerging markets' in the eastern half of Europe obviously do not quality for network society status. Russia does get targeted but all its former colonial territories are consciously left out.

denotatively empty and connotatively unimportant void.

Yet as noted earlier, many of these 'excluded' economies in Africa, the Caribbean and Central America are actively involved in the production and development of the information economy, albeit in a different capacity to those in developed nations (i.e., as manual labour providing raw materials or manufacturing, low-paid back office function rather than high-order information processing).

The connotative power of Europe, at the centre of the network society, is assisted denotatively because the territorially compact countries are well filled with the large doughnut symbols. For other countries, with larger territorial extents, these symbols look much less impressive and a stuck somewhat awkwardly in the middle, signify a relatively empty zone of activity, with network society concentrated only at this one point (e.g., the USA, Canada, China). Europe also gains in status by the denotative North-South division in the map layout by placing nearly all text boxes and ancillary material in bottom of the map, connotatively in regions that do not matter so much to the network society, which is securely located in the region above.

Besides their geographical distribution, the doughnut symbols themselves are open to interpretation. At one level they are not effective denotatively for statistical comparison between countries and their interpretation is made harder as the three colour-coded rings have widely different scales (e.g., why does the USA score better than Finland?). Connotatively, they imply complexity and show excessive difference, with too many rings empty for countries outside the West. Even the emerging BRIC economies barely register any colours on their doughnut rings. The extent of bareness is confusing connotatively, how can they be ranked in the network society if they denotatively don't have any PCs or Internet hosts? Also, what is the connotative meaning of the doughnut symbol design itself? It has a quasi-militaristic appeal of a target on a firing range. Does these signify the value of countries as different business 'targets', their worth denoted directly by the large number in the bull's-eye for business in the network society. The number '1' target of USA is worth more than Indonesia at number '49'. No target symbol on a country connotes that it is not worth targeting by corporations.

In conclusions, the 'Network Society Map' leaves much of the world unmeasured and unmapped. The selection of criteria measured and mapped to denote 'preparedness' of the countries for competition with each other are wholly concerned with technological superiority, with no wider social or cultural dimensions. A great deal of variation and inequality is evident in the 'Network Society Map', which in its desire to show technological progress and prowess, only targets the best 49 countries with attention. The map is a divergent view of the world.

5.6.3 Dasymetric-based mapping of Internet globalisation

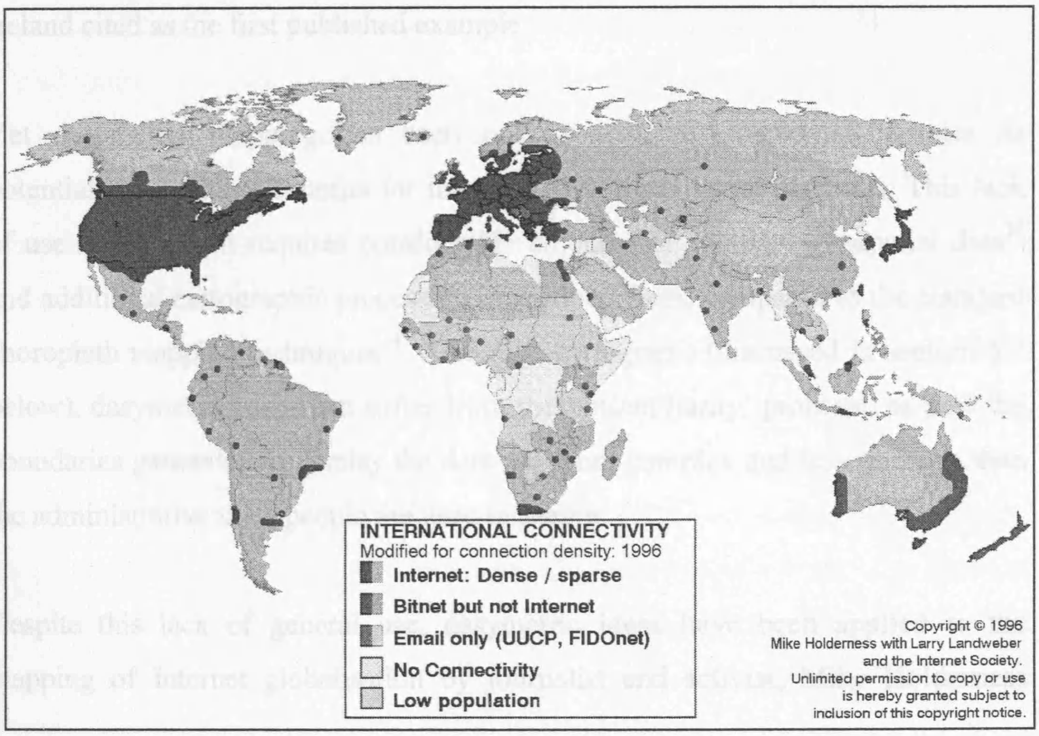


Figure 5.15: A hand-drawn dasymetric style map of 'International Connectivity' produced by Mike Holderness. It is a consciously political 'adjustment' of Landweber's original map that seeks to undermine the myth of rapid Internet diffusion. (Source: Holderness's website, <www.poptel.org.uk/nuj/mike/cyberdiv.htm>.)

The dasymetric technique for cartographic representation seeks to ameliorate the gross areal averaging inherent in choropleth maps by explicitly recognising the internal spatial distribution of the phenomena being represented to create a new set of zones to display the data. The goal is, therefore, to map the statistics, as far as possible, to their 'natural' zones rather than to arbitrary, prescribed units of publication (mostly based on administrative convenience). The primary application of the technique has been in mapping social phenomena, particularly population distributions. It can be argued that the dasymetric mapping methods give a more denotatively 'accurate' (i.e., spatially realistic) - and hence a more connotatively persuasive - visual representation. The dasymetric method can "help us to escape from the spatially bounded conceptions of human life produced by the choropleth map" (Crampton 2004, 50). Robinson (1982) traces the lineage of the dasymetric approach back to the 1830s, with the Harness population map of Ireland cited as the first published example.

Yet dasymetric mapping has been only sporadically deployed, despite its potentially significant benefits for mapping area-bases social statistics. This lack of use is because it requires considerable amounts of ancillary geospatial data[33] and additional cartographic processing to produce them, compared to the standard choropleth mapping techniques[34]. Also, like cartograms (discussed in section 5.7 below), dasymetric maps can suffer from the 'unfamiliarity' problem, as new the boundaries generated to display the data are more complex and less uniform than the administrative units people are used to seeing.

Despite this lack of general use, dasymetric ideas have been applied to the mapping of Internet globalisation by journalist and activist, Mike Holderness

[33] In terms of social mapping, necessarily detailed, small-scale, data on population distributions have traditionally been unavailable - although technical developments in urban remote sensing and household level geodemographics are changing this, at least in the UK (cf. Longley and Harris 1999). In many ways, Martin's (1996) extensive work on surface-based population representations from the census provides one of the best routes to generating data needed for dasymetric mapping.

[34] The availability of GIS, enabling greater flexibility in the manipulation and aggregation of spatial data, has made it potentially easier to create dasymetric maps (e.g., Mennis' 2003, work using ArcView). However, as far as I am aware, no major GIS package yet provides a 'point-and-click' function to generate dasymetric maps. Indeed, the help system for the market leader, ESRI's ArcGIS, contains no reference to them.

(1998). He states he was troubled by the level of abstraction in the 'International Connectivity' maps, how they portrayed an unrealistic viewpoint on the extent of world-wide network diffusion, and decided to produce his own approximate, hand-drawn reconfiguration as a political counter-map (Figure 5.15; it is also reproduced as a full page image in appendix two, Figure A2.13). Although he does not recognise it as such, his map has many elements of dasymetric design.

Holderness' adjusted map removes some of the most significant elements of distortion from the 'International Connectivity' map (he used the second to last map from 1996 as his starting point, reproduced in appendix two, Figure A2.2) by fading non-metropolitan regions outside of the OECD core nations to account for their likely much lower 'connection density' and also greying out the uninhabited deserts and arctic tundra. Holderness has effectively doubled the complexity of the classification, so as to make "a first approximation at a realistic map" (Holderness 1998, 40), by introducing the notion of dense and sparsely networked regions (in many ways mirroring the more complex division in the original 'International Connectivity' data tables; see Figure 5.6 above). Although the representation of dense and sparse areas was acknowledged as cartographic guesswork on Holderness' part, the result is a view of the world with a very much more constricted degree of Internet globalisation, and with network connectivity significantly more spatially concentrated, than implied by the homogenising choropleth display of the last few of the 'International Connectivity' maps. (For example, Russia, China and Australia seem to be much less completely networked in dasymetric form compared to the choropleth representation in the 'International Connectivity' map.) The rich, dark purple shading of full Internet connectivity is very much more constrained to the core regions of the developed world in Holderness' presentation. It is also interesting to see that Holderness is willing to create his zoning scheme by curving the boundaries of different connectivity levels across national borders (e.g., between the U.S. and Mexico) which is arguably more realistic that the complete cut-off at the frontier implied by the solid black lines on the 'International Connectivity' map. In this fashion Holderness is by implication breaking down the primacy of the nation state metageography, where countries as sovereign units must be denoted as completely separate and self-contained on conventional world maps.

In connotative terms Holderness (1998, 40) says of his map, "it is not dissimilar to a map of per capita income - or, for that matter, one of where the white folks are". The global south is clearly rendered connotatively as markedly unequal periphery through the use of faded colours, while the distinctive 'spotty' appearance highlights to the map reader the tight concentration of the best connectivity in very few principal cities (e.g., India goes from full purple in the 'International Connectivity' map to only three dark city spots). And one could argue denotatively that many of the spots are actually exaggerated and if drawn to scale would actually be dots of connectivity. In many ways then, Holderness' dasymetric mapping of the Internet highlights effectively the extent of continuing unevenness in network access and the complexity of patterns within countries and across regions, countervailing the more harmonious picture painted in the 'International Connectivity' and DOI maps. As such, on the fourfold connotative schema for maps of Internet globalisation, this dasymetric view of the world should be placed in the quadrant for map with disorderly meanings.

5.7 Cartogram-based mapping of Internet globalisation

Cartograms are a hybrid of map and diagram in which a scale manipulation of distance or area is deliberately employed to highlight the structure of the thematic data at the expense of geographic accuracy. The most common technique is the 'value-by-area' cartogram where the units of enumeration are drawn scaled according the statistical data and not their customary territorial extents.

Even though there is a relatively long history of cartograms production, dating back to innovations in the 1860s in statistically representing data for European countries (see Tobler 2004 for review), they have not been commonly deployed, particularly compared to choropleth maps. This is due, in part, to the fact that they are perceived as being more demanding to produce, and in an era of automated cartography, most software packages still do not provide cartogram drawing functions[35]. When cartograms are deployed, it tends to be for consciously political reasons and a case is often made that they offer a more socially progressive way of mapping people, particularly at the global scale (Vujakovic 1989). For example, the political case for cartograms for radically re-presenting global social geography is explicit within the work of the Worldmapper project at Sheffield University, as they claim their eye-catching cartogram design "enables a more democratic representation of the population of the world, where people are treated as equals regardless of where they live" (Barford and Dorling 2008, 68). Cartograms are said to be rhetorically powerful because they eliminate the "fundamental distortion of much past thematic cartography in (literally) drawing our attention to the patterns in places where the fewest people live" (Dorling 1994, 85) and thus offer a connotatively 'fairer' scheme of visual representation, particularly at the world scale (e.g., small, densely populated states can be easily seen and sparsely populated territory shrinks). The goal in their use is, therefore, to stimulate new ways of thinking about social patterns represented by denoting them in a way that goes against convention (e.g., cartograms used in Kidron and Segal 1995).

The major disadvantage of cartograms is their unfamiliar denotative appearance to readers. Cartogram algorithms, particularly contiguous ones that attempt to preserve boundary adjacency, can produce very warped country outlines, eliminating conventional shapes and shifting well-known landmarks, such that people, who have been imprinted from a lifetime's exposure to the 'normal' visual geometry of world maps, find them confusing and difficult to read. (The extent of distortion to conventional shape is a very evident issue, for example, in the Worldmapper cartograms; selected examples shown in appendix two, Figures A2.15–A2.18). Such denotative unfamiliarity can, of course, be viewed as a connotative benefit as it can spark interest and help to challenge complacent viewpoints - "[t]he appeal of cartograms no doubt results from their attention-getting attributes" (Dent 1995, 208). However, it can also reduce the effectiveness

[35] Various custom scripts and programs have been developed to create cartograms (e.g., Dykes' (1997) 'cdv' system), but the extra effort required is usually not justifiable, compared to the ease of producing a choropleth map.

of the map because people focus their attention more on the mapping technique than on the actual data being represented, thereby breaking one of Tufte's (1983) maxims for good information design.

Cartograms are potentially interesting semiotically as a representational technique to change the conventional denotation of statistical views of the world that has connotative impacts beyond just 'shocking' the audience out of complacency – they can connote a uncluttered and more lucid world picture. Such a smooth, simpler and more straightforward appearance of nations for example, unencumbered by the complex twists and turns of borders and coastlines, implies a greater clarity of understanding of the statistical trends and highlights differences not noticed before. In the context of representing Internet globalisation under examination here, the interesting question is whether the connotative meanings in cartograms suggest a more divergent pattern in comparison to the tendency of choropleth maps to present a convergent view of the world coming together.

A number of cartogram techniques have been applied by several different individuals and groups to represent the extent of networking across the world. It should be acknowledged that the distribution of most of these cartograms of Internet globalisation has been limited, especially in comparison to the two main choropleth-based examples considered above ('International Connectivity' and the DOI maps) and they should perhaps be viewed as rather experimental interventions into the discourses of network development. As such they have likely had little impact on reshaping the wider discourses about the worldwide extent of Internet globalisation, but do offer alternative connotations that are worth considering, particularly if an organisation with influence, such as the ITU, were to decide to deploy cartograms rather than choropleth-based world maps in the future.

Distance-based cartograms using a linear scale distortion according to cost, time or speed of travel have been employed to show how communications connectivity is differentially re-scaling relationships between places, for example Arrowsmith and Wilson's (1998) 'telecom tectonic' world maps (example reproduced in appendix two, Figure A2.14). Crude aesthetically, their cartograms denote the distance between countries in terms of the uneven costs of telecommunications, which they claim connote differences between cyberspace and physical, highlighting the "location of electronic ghettos ... of the electronic world" (Arrowsmith and Wilson 1998, 8) not apparent on conventional choropleth maps.

Value-by-area cartograms have also been used to show Internet globalisation, including the work of the Worldmapper project, using their novel equal area diffusion algorithm that attempts to preserve boundary shape and adjacency of nations[36]. The Worldmapper team are publishing online hundreds of world cartograms on a myriad of social, demographic and economic themes using public national-level statistics. They have created two cartograms of Internet users per capita, for 1990 and 2002 survey points – the results denote the northern hemisphere nations as greatly enlarged, connoting images of being blown up like balloons and the Global South shrivels almost out of existence (reproduced in appendix two, Figures A2.15-A2.18). Their goal is to highlight scale of inequality by exaggerating the connotation of divergence between regions of the world in the hopes of bringing about changed policies (which would ultimately bring about changes to the patterns denoted, making the world a more harmonious social space). Their 2002 cartogram poster, for example, asserts this agenda through a human voice in the following quote: "we strive to achieve a 'warm-hearted digital world' where everybody ... enjoys ubiquitous access to communications technologies for the greater good" (reproduced in appendix two, Figure A2.17). The denotative and connotative meanings of their cartograms can, in some senses, be correlated to Barford and Dorling's (2008, 108-09) dual scientific objectives expressed in their work: "These cartograms are scientifically (in the natural science sense) [and denotatively] interesting as they result from the beauty and elegance of solving an algorithmic problem. These cartograms are also scientifically (in the social science sense) [and connotatively] interesting because they show how we live now – they deliver a clear message about the current state of the world."

[36] Developed by U.S. academic physicists Michael Gastner and Mark Newman. Further details at <www.worldmapper.org>.

The more easily constructed and thus more commonly drawn cartogram design is the non-continuous one and there are several exemplars that map data relevant to the theme of Internet globalisation, including ExploMap Technologies' cartogram using a relatively simple design of scaled square blocks representing the number of Internet users placed directly on top of world map of country boundaries; Govcom.org's 'digital divide cartogram' has an interesting twist in that country size is drawn inversely proportional to level of Internet usage, so the nations with least become the most visible; and Byte Level Research's cartogram ignores geopolitical boundaries by focusing on the global politics of Internet domain names with nations represented solely by their country codes scaled according to the size of population (these three different cartograms are reproduced in appendix two, Figures A2.19, A2.20, A2.21)[37]. Two further non-continuous cartogram examples will be considered in a little more depth because they have a rather more sophisticated design perspective and significant political agendas – the first is from a U.S. technology magazine and connotes the 'wired world' as a set of business opportunities and under-developed markets, the second is a project by an Italian artist questioning the unequal growth in the Internet in relation to population geography by exploiting the iconicity of nation-state flags.

[37] Original pdf versions of them are currently available from:

- <www.bytelevel.com/map/ccTLD.html>,
- <http://explomap.free.fr/world_map_internet_users_2005.pdf>,
- <www.govcom.org/maps/map_set_wsis/GC0_Maps_set_3.0_digitaldivide_invert.pdf>.

5.7.1 'Wired World Atlas' cartogram

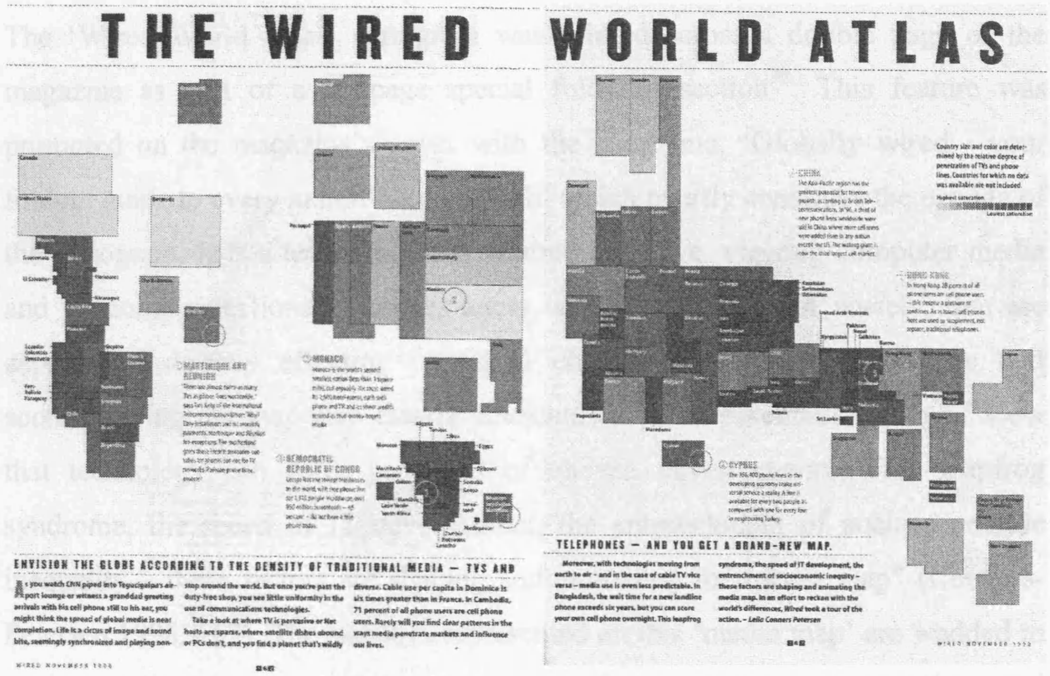


Figure 5.16: The 'Wired World Atlas' displays national-level statistics on telephones and televisions per capita using a non-contiguous cartogram technique. (Source: author scan from Conners-Petersen 1998, 162 and 167.)

In 1998, at the height of the 'dotcom' boom and the hype around the transformative potential of the Internet and worries about those people and places trapped on the wrong side of the digital divide, Wired magazine featured a large non-contiguous value-by-area cartogram, entitled the 'Wired World Atlas' in its November issue. In the cartogram countries are denoted as rectangular blocks, scaled according to telephone lines per capita and shaded by the penetration of television (Figure 5.16; a larger version is reproduced in appendix two, Figures A2.22 and A2.23). Wired magazine is a U.S. technology lifestyle magazine with a strongly libertarian and utopian outlook on the Internet, and in the mid 1990s was considered something of a 'bible' for the true believer in cyberspaces' potential to change the world for the better (Jordan 1999). Their conscious decision to use a visually novel cartogram representation rather than a more conventional choropleth world map is in keeping with the design pretensions of the magazine which often features alternative and colorful info-graphics.

The 'Wired World Atlas' cartogram was printed across a double page of the magazine as part of a six-page special fold out section[38]. This feature was promoted on the magazine's cover with the strap line: 'Globally wired - your foldout guide to every nation's tech wealth' which overtly construes the agenda of the cartogram. It is a technologically centred narrative, viewing computer media and telecommunications as actives agent, existing 'outside' of society, that are capable of directly effecting (positive) changes social behaviour. The text accompanying the map also clearly advocates a developmentalist point of view that technology can solve problems of uneven development: "This leapfrog syndrome, the speed of IT development, the entrenchment of socio-economic inequality – these factors are shaping and animating the media map" (Conners-Petersen 1998, 167). The statistics represented on this 'media map' are wedded to commercially-driven, positivist measures of infrastructure penetration and technological progress, failing to reveal the nuanced role that many developing nations play in supplying and supporting the information economy of developed nations.

[38] The other four pages feature a large summary chart, entitled 'The Media Spectrum', showing countries classified by eight different statistics accompanied by short anecdotal portraits of how technology is improving individual lives in different countries.

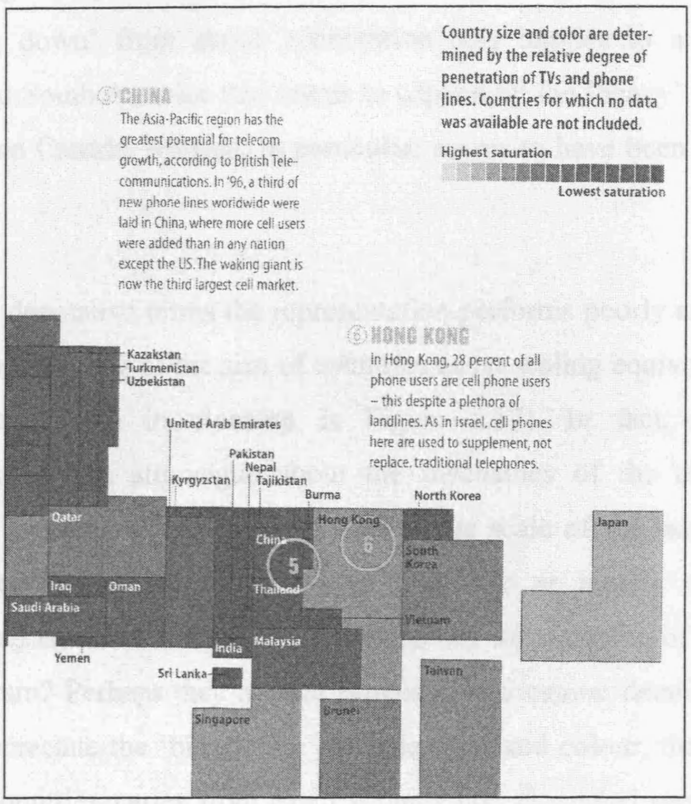


Figure 5.17: A subset image of part of the 'Wired World Atlas' cartogram. (Source: author scan from Conners-Petersen 1998, 167.)

Design wise the cartogram is actually a quite familiar shaped world view, albeit with a strongly rectilinear manifestation, with the established cardinal orientation of north at the top, America to the left and Australia on the right, and the continental groups all in the right places. In denotative terms a major change from world scale choropleth maps, such as the 'International Connectivity' and DOI considered above, is that countries can not be recognised by their familiar outline shape so must all be labelled for identification. Many counties do maintain, approximately, their correct geographical adjacency to each other. Representing nations scaled by the statistical values rather than their territorial extent results, in general terms, in the countries in the Global North being denoted as larger and lighter coloured, compared to the rather undifferentiated mass of nations in the southern hemisphere, which tend to be much smaller and more darkly shaded. The most striking visual feature of this cartogram, in connotative terms, is the shrunken-looking African continent which seems to be overwhelmed by huge, overbearing European country blocks. Although slightly less oppressive, this 'squeezing down' from above connotation also applies to a stunted looking Central and South America that seems to capped by the 'heavy' golden blocks of the U.S. and Canada. Mexico, in particular, seems to have been squashed flat by their bulk.

In specific denotative terms the representation performs poorly as it is impossible to judge the meaning of the size of countries as no scaling equivalence is given in the legend (shown in close-up in Figure 5.17). In fact, the legend and accompanying text are vague about the mechanics of the classification and denotative meaning of the shading; what is the scale of the saturation meant to indicate? (Whether this vagueness is deliberate or merely oversight is not discernable.) How are readers to reliably decode the meaning of two variables in the cartogram? Perhaps they are not supposed to focus on detail of each country but just appreciate the 'big picture'. Besides size and colour, the actual shape of different countries varies from exact squares and elongated rectangles, to some with odd blocky protrusions. Again, it is not clear whether this denotes information or is simply artistic license by the designer (the shape of Italy would suggest shape is used arbitrary for decorative purposes alone.)

Even though the denotative meaning of the size and shape of countries is unspecified and therefore uncertain, the potential connotative meanings are interesting to speculate about, particularly how to read the meaning of narrow-vertical nations (do they appear to be 'skinny' and rather 'puny'?) in comparison to the wide-horizontal countries (which seem 'fatter'). This thin/fat visual dichotomy, arguably, creates subconscious perceptions of the differing potency and worth of nations – in this case square-fatter shaped countries appear superior visually and thus are judged as being superior places. The variations across Western European nations, between wide ones and tall ones, is an interesting case in point; connotatively how do France and Belgium compare, or more dramatically in terms of visual prominence, Monaco and Switzerland?

The case of Monaco's representation in the 'Wired World Atlas' also highlights another key denotative aspect of the cartogram in that it offers clarity of representation in some respects in that many small nations can be seen at the global scale. As noted above, on the 'International Connectivity' and DOI maps many small nations can not be discerned visually, and connotatively they do not exist in the mapped world. In Figure 5.16, the tiny principality of Monaco is actually the most visible nation at the centre of Europe, with the largest graphical extent and a bright yellow shading which makes it stand out from the darker hue colour of its neighbours. Connotatively, Monaco is clearly an important nation in the wired world, a point reinforced denotatively by the addition of a textual citation next to the cartogram informing readers that it may be small in land area but is 'arguably the most wired'. The text goes on to point out the obvious explanation for this 'superpower' status in the wired world – "its sheer wealth remind us that money begets media." This hints at the fact that per capita wealth is actually the real factor determining denotative visual presence of countries on the 'Wired World Atlas'.

As well as highlighting the small and wealthy nations, the cartogram seems to give undue denotative attention to a select few island economies which are most 'plugged' into wired world. Such islands are normally mere specks in expansive seas and oceans on conventional map projections. The 'wired' islands that are most apparent are in the Atlantic with Bermuda, the Bahamas and the Antilles, typically invisible on world maps, shown are hefty-sized blocks in their own right. Indeed, Bermuda seems like some kind of new Atlantis, drawn as large as North America and connotatively inviting favourable comparisons between the two nations. While in the southern hemisphere, the whole African continent (undersized denotatively and connotatively an unwired zone of 'failure') is visually hemmed in by an enlarged Cape Verde island and a combined island block representing Réunion, Seychelles and Mauritius; this bright red block is denotatively bigger than the whole of southern Africa (it also receives additional attention as a 'noteworthy place' via a text citation). The way these islands are mapped is also interesting as it provides clear evidence of selective cherry-picking as many other island nations – one suspects the poorer and much less wired one –

are consciously not represented on the 'Wired World Atlas'. For example, much of the Caribbean seems not to exist.

In terms of visual clarity, the African nations are clearly a denotative design 'problem' on this cartogram. Given their low scores in 'wired' rankings they are drawn as small and indistinct squares, whereas on conventional territorial projection they are easily visible. They are also shaded in dark purple hue that connotatively seems to resonate with Cosgrove's (2003) notion of 'cartographic gloom' and recreates the dark heart of Africa, reminiscent of European maps of the continent from the age of empires. Some of these small and landlocked nation 'squares' do not even get labelled – signally connotatively that they do not need to be named, they are indistinguishable and do not really matter in the wired world.

Another advantageous dimension of cartogram designs in general is that they can often be seen as an improvement over conventional choropleth maps in their capacity to make readers to think anew and undertake qualitative comparisons between places when seen in a different projection. Certainly some of the visual juxtapositions on the 'Wired World Atlas' prompt reconsiderations of relative importance between neighbours and may overturn perceived hierarchies based on unequal territorial size alone. For example, which is best in connotative terms when comparing the UK and Ireland? It is hard to say, and their representation on the cartogram implies near equanimity between what have traditionally been viewed as very asymmetrical neighbours (particularly given the colonial legacy[39]). One might argue that the representation is now more accurately reflecting the changing economic balance as the UK economy has declined in comparison to the boom enjoyed by the 'Celtic tiger' in the last two decades.

Other connotatively intriguing regional power re-configurations include eastern Europe versus Russia. Denotatively, Russia is very small scaled on the cartogram, connotatively a tiny sliver of a nation unlike its usual connotation of a vast territory spanning a third of the world from Europe to the edges of Asia. In the

[39] Interestingly, the denotative simplification of representation in the cartogram allows the territorial ambiguity of Northern Ireland be overlooked.

'Wired World Atlas' its power, accruing from sheer land mass, is lost and it is rendered at a scale comparable to former socialist republics of Belarus and Georgia and appears connotatively to be somewhat less important than its former colonial territories, and now newly vitalised, Baltic states of Estonia, Latvia and Lithuania.

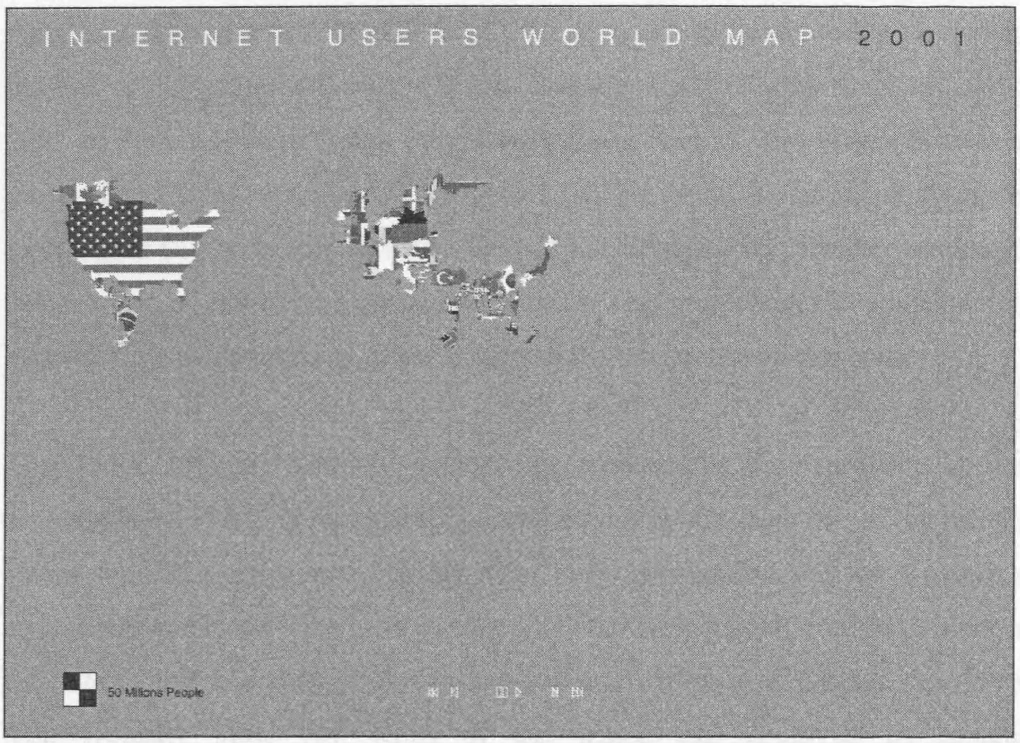
In Asia, there are several potent reversals of normal power relations evident, including the two populous superpowers of India and China which are shrunken significantly. The diminished size of India and China (which can visually dominate population-based cartograms) shows that the geometric calculation of power in the 'Wired World Atlas' depends not on people per se, but on wealthy people. It would be interesting to speculate what this cartogram would look like redrawn with 2008 data, and the degree to which the intervening ten years of double-digit technology-driven economic growth in China has really changed the per capita performance that much. In terms of comparative geopolitical visualities in the cartogram, the contrast between Pakistan being drawn as larger (and above) India is noteworthy given their bitter national rivalries, along with the juxtaposition of Hong Kong drawn much larger and brighter than China proper.

One last theme to consider regarding the meanings given out by this cartogram is the degree to which it does connote the *whole* world, as it denotatively purports to be. The legend texts hints at the ambiguity that the cartogram is not actually a guide to '*every* nation's tech wealth' by admitting that no data, means no representation (Figure 5.17 above). So territories that do not rank statistically, literally do not count - they are made to disappear from the 'Wired World Atlas'. Denotatively the cartogram is made up of a profusion of nation blocks but there is not enough of them to connotatively represent the world effectively. The count of blocks shows about 140 countries represented on the cartogram, which is about forty nations less than mapped by the DOI (which is itself less than 193 sovereign states recognised by the UN). What is missing? Its hard to identify countries left unmapped but it likely to be places that do not count strategically to U.S. interests or do not offer attractive market opportunities (e.g., some small poor Caribbean nations). So while the headline text under the cartogram may claim that it 'envision[s] the globe', it is only on a partial viewpoint, and while it might be a 'brand-new map' it exhibits many of the old geopolitical devices of silencing, ethnocentrism and visual ordering based on social power found in other world maps.

Given these limitations, how does the 'Wired World Atlas' score in terms of the fourfold categorisation of connotative meanings for representations of Internet globalisation? Some denotative elements of design – the saturated colour ramp, the regular shape to the symbols and the spatially contiguous spatial representation of each nation[40] - means it is simplified picture which strongly implies an orderly world. This connotation of relative orderliness is enhanced because the transitions in country block size and shading are, broadly speaking, gradual across the continents, with relatively few sharp divides between adjacent nations. In many ways then this cartogram suggests an ordered and convergent world, however, this is at odds with much of the surrounding text annotations and commentary along the bottom of the page which consciously highlight places of difference and of concern[41] (e.g., a particularly negative comment is associated with Africa by choosing to highlight the Congo as the worst performer in the world.) "Rarely will you find clear patterns in the way media penetrate markets and influence our lives" notes Conners-Petersen (1998, 162), which does not suggest a convergent pattern. (This could be a case of the visuals and the text being authored separately and the editor not being fully aware of the clash of connotations; cf. Vujakovic 1999a.) Furthermore, differences between continents evident in the relative scaling of the blocks, does highlight in an unavoidable fashion the degree of inequality in the world; the shrunken African continent in contrast to Europe is especially powerful connotation of the gulf of difference in the wired world. The extent of order, combined with evident difference exhibited in the 'Wired World Atlas' mean it should be positioned in the upper left quadrant on the fourfold grid of connotative meanings.

[40] Avoiding the visual complexity and disharmony of nations with split territories, such as the U.S. or geographically fragmented nations such as the Philippines.

[41] Note, text is more legible on the larger versions in appendix two, Figures A2.22 and A2.23.



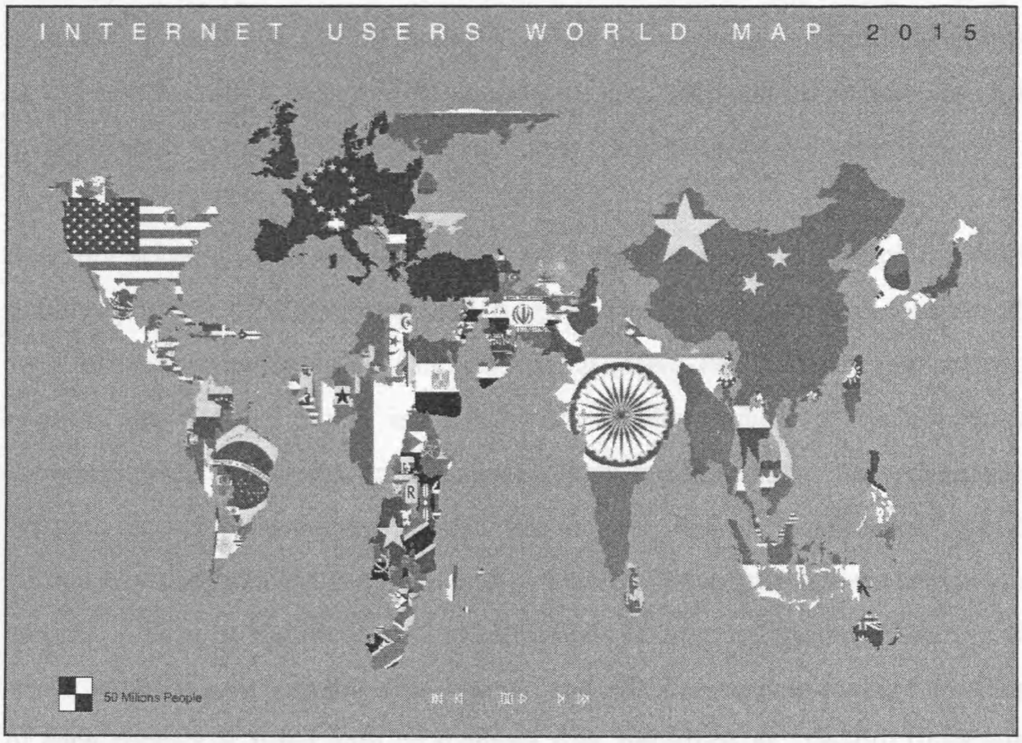


Figure 5.18: Screenshots of two frames from an animated cartogram visualising the growth of Internet users created by Antonio Scarponi. The top image is from the middle of the animation and the bottom image is the last frame. (Source: GlobaLab, <www.globalab.org/eng/>.)

5.7.2 'Internet Users World Map' cartogram

Another noteworthy project exploiting the cartogram approach to try to envision Internet globalisation differently is the 'Internet Users World Map' created in 2002 by Italian architect/artist Antonio Scarponi, as part of a larger critical art project he calls 'Human World'[42] (Figure 5.18). He describes his mapping project as "an atlas that propose a representation of the cultural and political information of our world displayed on a demographic basis. This project uses Boetti's mapping code by flipping the concept of the flag from the territory to its population."[43]

The design aesthetic Scarponi deploys for representing the world are country outlines filled with their national flag. Denotative this conflates two of the primary visual signifiers of national identity - the territorial outline and the emblem of state. Flags and maps often have overlapping emotive connotations, particularly as they are interwoven with patriotism and nationalistic politics (Vujakovic 1999a). Yet, typically these two icons of the nation are deployed as separate representations; Whyte (2007) reports only one national flag (that of the Republic of Cyprus) features a recognisable country outline, although other flags do make symbolic calls to cartographically related theme and geopolitical narratives.

Scarponi acknowledges his deployment of the cartographic design of the world doubly 'politicised' through national flags is a notion copied directly from the work of another Italian artist, Alighiero Boetti (1940-1994). Given this aesthetic relation, the work of Boetti is of relevance to the reading of the conceptual meanings Scarponi's cartograms. Boetti was fascinated by the relationship between chance and order, systems of classification, and many aspects of culture, particularly non-Western traditions and practices. These interests are reflected in aspects of his most significant art works, a series of large embroidered maps of the world, made in collaboration with Afghani and Pakistani artisans, where the shape of each country is filled with its national flag, described as "vividly illustrating

42 Available online at <www.conceptualdevices.com/ENG/Human%20World/index.html>. The other maps use the same country-flag cartogram design but represent different statistics, such as national rankings for democracy and the use of the death penalty.

43 Source: <http://point-view.blogspot.com/2007/04/space-in-picture-is-like-property.html>.

our world of fiercely demarcated individual nation states."[44] In contrast to signs of demarcation, others have argued, the interwoven pattern of countries in Boetti's work, resulting denotatively from the embroidery technique in the making of the map, symbolises the interdependence of states (Storr 1994). In some senses, Boetti's world maps also connote that national boundaries are not as fixed as they can appear in conventional cartography, involved as they are in a constant process of flux and negotiation due to geopolitical events (such as the reunification of Germany, or the break-up of Yugoslavia)[45]. The maps, then, have multiple and potentially incompatible connotative readings (just like Scarponi's cartogram, see below). This instability of meaning resonates with Boetti's own creative practice, which he self-effacingly described as follows: "[f]or me, an embroidered map couldn't be more beautiful. I did nothing for this work, chose nothing myself, in the sense that the world is shaped as it is, I did not draw it; the flags are what they are, I did not design them. In short I created absolutely nothing. When a fundamental idea, the concept, emerges, there is no need to decide on anything else."[46] This comment, in its overt naivety that the shape of the world is merely 'given' to him, I think clearly suggests that one needs to think very carefully about why the world is shaped way it is on his maps.

Scarponi's own art work, 'Internet Users World Map' is a short animated non-contiguous value-by-area cartogram (delivered online using Flash) that shows the countries scaled according to the number of Internet users (Figure 5.18 above). To achieve the re-scaling, he claims each pixel represents a thousand people, in what he describes as a 'demographic' projection. The animation of maps runs from 1993 through to a future projection in 2015 and denotes how the configuration and relative scaling of countries changes as differential growth in the Internet user population plays out. In the beginning, the U.S. dominates the field of view, with

[44] Source: <www.tate.org.uk/modern/exhibitions/artepovera/boetti.htm>. A noted example from this series, *Mappa del Mondo, 1989* (140 x 220 cm) is on view in the permanent collection of the New York Museum of Modern Art. Photographs of a range of Boetti maps are presented here, <http://www.orbit.zkm.de/?q=node/357>.

[45] A point made visually in Scarponi's animation through the merging of European nation into an imagined single Euro-land under one flag (discussed below).

[46] Source: <www.orbit.zkm.de/?q=node/357>.

Latin America and the African continents barely visible (except for Brazil and South Africa), yet towards the end of the sequence, North America shrinks from prominence as the maps become visually dominated by the expansion of India, China and the central African states (based on future *projected* online population growth in those countries). Also, some territorially large nations, which tend to dominate conventional geographically projected world maps, shrink away because of their relatively small online presence – the most noticeable being Russia, Canada and Australia. Separate European nations merge overtime to become a single EU super-state in the middle of the world map, the nature of the bright blue flag connotes a dominant monolithic expanse (by the end of the animation sequence only the Swiss flag exists to disrupt European unity).

Overall the cartogram has many denotative problems around the legibly of the information displayed and the difficulties of interpretation for many people with limited awareness of the design of national flags and the shape of nation states. As a mode of identification the rectangular shaped flag designs are often poor choices, particularly when they have had to be tightly cropped to fit irregularly shaped countries. This makes recognition a challenge in many parts of the map and clearly disadvantages those nations without a strongly iconic flag (or with a flag not known to wider readership). Denotatively, then the primary meaning of the map is one of cartographic muddle as a jumble of odd sized bits of pattern and colour grow and jostle around.

Beyond explicit issues with design effectiveness and denotative legibility, there are several important connotative meanings expressed through this cartogram. Firstly, many flags are only recognisable when shown on territorially extensive countries and consequently small countries cannot be identified and are silenced. The outcome is that the citizens in these nations are given no more connotative significance than on the conventionally projected choropleth maps of the world. As a politically motivated cartogram, it does not address the fundamental equalities with territorial delineation. As a result it is very much the same select few countries (those that dominant global discourse and are widely represented in the media as leading the international community) reified in Scarponi's cartogram.

The effect of using flags as land cover can have other disconcerting connotative results. The dominance of China for example, with its large land area and population base is magnified through the simplicity of the Chinese flag design, with it assertive singular red colour. The result is a monolithic area which gives off menacing connotations of 'threat from the east'. In comparison, the design of India's flag with its three distinct bands, denotatively splits the nation and this connotes as a divided country, with diminished capacity (and threat to Western interests) compared to China.

Scarponi's invocation of the cartogram as a supposed 'demographic' projection that focuses attention on people, rather than conventional representation dominated by territory, is interesting politically but is not delivered with his chosen design approach. Its emotive connotation to change understandings of the world is undermined precisely because of his choice of the primary semiotic vehicles of the territorial power - the country outline and the nation flag. The implied claim that flags can speak *for* people is problematic at best, they more likely signify state space.

Flags are culturally complex visual symbols in their own right, each one having layers of meaning and imbued with various historical belongings (Whyte 2007). For those outside of a culture, the symbolism embedded in the flags colours and patterns is obscure at best and many citizens probably do not know what their flag means; how many people can decode the meanings of the British flag? The narrative and symbolic meanings of flags are also unstable, varying over time and with contexts – the 'problematic' issue of the meaning imparted by displaying the Union Jack, for example, with it connotations of a tarnished colonial past and more recent associations with racist and fascist groups and the violence of football hooligans in the 1980s. This is in marked contrast to the rejuvenated position, for some, of the George Cross with positive connotations of English pride. In the U.S., the national flag has strong patriotic resonance for many, to the point where the protest of burning the flag is criminalized. The flag and map are often combined as political icons, particularly in conservative rhetoric. Edsall (2007, 343) notes the prevalence of 'flag-filled maps' in America which "emphasizes the difference between what is ''inside'' and what is ''outside'' the borders but, more importantly, implies a unity of spirit, purpose, and resolve. This monotone fill suppresses notions of internal variation (e.g., dissent) and connotes uniformity, a common mission, solidarity, and national pride."

Crucially, then, the deployment of national flags is not innocent as each of them brings with them all kinds of political connotations. Vujakovic (1999a 11) notes, "[f]lags are highly potent symbols of nationhood, and their importance is demonstrated by the multitude of ways in which they have been revived and incorporated into the iconography of resurgent nationalism in east-central Europe." So the complex profusion of flags in some areas on the cartogram (central Africa or the Middle East), one could read connotatively as an emergent maze of cultural diversity, political self-determination and the potential rise of nationalism as a powerful force reshaping the geography of states. The flag, in this sense, is an emotive sign producing "incitive connotations", which MacEachren (1995, 348) says tries to "stimulate action (or at least a desire that someone take action)." The profusion of country filled flags are perhaps a call to resist a globalising, convergent world of uniformity of media access. Yet, at the same point these forces are signified elsewhere on the cartogram by the strength and stability of the flags of powerful nations (the EU, the US and China), which are visually dominant and most legible in denotative terms.

Overall, then Scarponi's cartogram approach is a conscious attempt to visually restructure the readers understanding of Internet globalisation through a map that focuses on population and not territory but is flawed in many respect because it is fundamentally still premised on nation-state geopolitics and not people as social actors. It is founded on the nation as the basic units of measure and representation (reified, of course, by the iconography of national flags). Despite its intentions it is connotatively analogous to the 'International Connectivity' and DOI maps in many respects, with the emphasis on the power of nation-states to visualise and explain the impact of the Internet.

In terms of the fourfold grid of connotative meanings, it is apparent that Scarponi's cartogram defies clear classification into a single quadrant. Semiotically it speaks to global consolidation and growth, but also invokes countervailing notions of nationalism and splintering of world into many separate spaces. It is a picture of a converging world in the sense that countries seem visually to be getting closer, stemming in part from the denotative use of a growing cartogram, and also in the sense that growing Internet use is all about convergent media practices, but it also connotes diverging world because it highlights trends that are locally variable and, in part, nationally regulated, hence the flags.

5.8 Discussion

Given the many issues with how the above maps connote divergent or convergent patterns, is it possible to conceive of more progressive, although not necessarily more 'accurate', approaches to the analysis of Internet globalisation? Maps that overcome the culture of ranking, which tends to encourage competition rather than cooperation, pitting country against country, rather than highlighting common causes of difference. In a neoliberal socio-economic contexts benchmarking tools such as the DOI are seen as beneficial as both a measure of, and also means to encourage, competitive behaviour between economies. Policies are enacted with an eye to the rankings and to improve the score (e.g., Japan and Korea vying for top spot; rivalry between Hong Kong and Singapore as most efficient Asian hub). Focus is on score not necessarily what it means for changing and improving the lived experience of people (as a very different scale, rankings of the world's top universities can be seen to perform in the same way).

Getting beyond the ranking culture may means more than 'tinkering' with alternative representational forms and indicator choices, to think about different conceptions of measurement and, indeed, very different types of questions about the nature of the Internet and so-called information society. In addition to measuring Internet availability and activity, some have argued for an empirical assessment of the Internet focused on *utility* in terms of peoples' capacity to exploit it[47]. For example, Gurstein (2003, no pagination), using ideas from community informatics, has called for the analysis of digital divides to look at 'effective use' of the Internet in local settings that focus on the ability to actively participate in the production as well as consumption of the networks. In relation to the Asian Tsunami and supposed 'failure' of communications in the region, Gurstein (2005, no pagination) notes:

> "From what I can gather most if not all of the communities impacted [by the tsunami] had Internet 'access' in one form or another. What they (and here I would include those with the knowledge who couldn't use it as well as those without knowledge) lacked rather, was the social, organizational, informational, and applications infrastructure which could have turned Internet access into an 'effectively usable' early warning system."

Conceptualising Internet measurement in terms of the ability for individuals and communities to take effective action online is also interesting conceptually because it moves the focus from 'top-down' measurement of infrastructure availability towards a more 'bottom-up' rights-based agenda for understanding Internet globalisation. Some commentators argue that the most socially relevant way to measure Internet globalisation now is as the 'freedom to access'. For example, Guédon (2002, no pagination), noting the 'completion' of the access project charted by the 'International Connectivity' maps through the 1990s, argued in a statement on the future role of the Internet Society that: "I believe a new kind of map ought to be issued each year by ISOC, and it would graphically display how the *rights* of access of cyber-citizens are respected or flouted, as the case may be", a consciously political mapping, meaning that "ISOC would raise a moral voice in the world, a voice that would say: not only do we guarantee the existence of our cyber-citizens, but we also defend their cyber-rights." There have been a number of 'moral mapping' projects with this kind of human rights agenda recently (e.g., mapping of Darfur crisis, cf. Parks 2008).

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[47] The DOI has one indicator, out of eleven components, that comes part way to capturing some notion of use but it tends to be lost in crowd of other infrastructure capacity indicators (cf. Peña-López 2007).

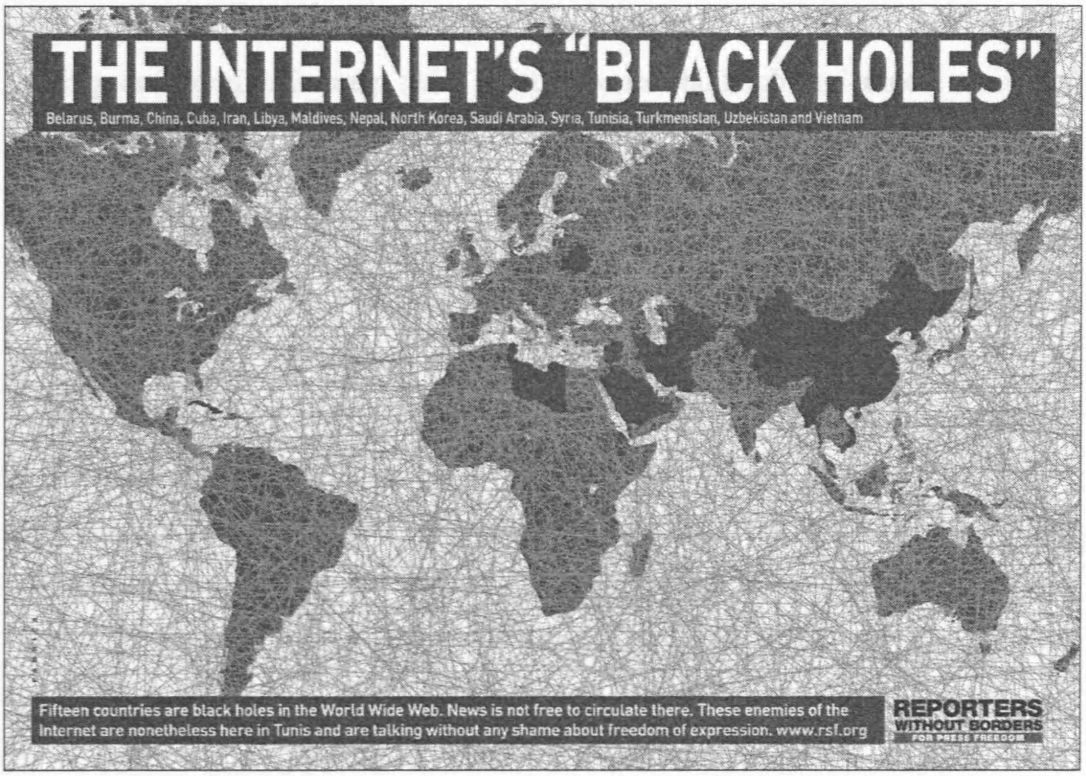

Figure 5.19: An overtly propagandist mapping of Internet globalisation in terms of online freedom, produced by campaigning NGO Reporters without Borders. (Source: <www.rsf.org>.)

In terms of Internet globalisation, Wired magazine produced a world map in 1997 entitled 'Freedom to Connect' (Conners 1997; reproduced in appendix two, Figure A2.31) denoting the extent of government censorship in five classes. Harpold (1999, 14), however, critiques the map's chosen way to measure 'freedom' saying "[t]he crudeness of the map's visual scale - distinguishing free from unfree connections in only five steps that must represent differences across all political-legal, economic, and technological contexts - begs the question: how meaningful is it to compare the 'freedom to connect' in Mexico City, Paris, Brisbane, and Algiers, and come up with the same result?" More recently in-depth annual studies have been produced by the NGO, Reporters without Borders comprehensively auditing inequalities in online access caused by governmental surveillance and censorship. The results are informative in that they show the highly fragmented nature of Internet globalisation, even in many OCED countries.

As part of a campaign to highlight the extent of surveillance to attendees at the

2005 World Summit on the Information Society in Tunis they published an striking and simplistic map of a binary world highlighting almost universal 'freedom' except for the 'black holes' (Figure 5.19; reproduced as a larger image in appendix two, Figure A2.32). Despite its stress on difference, it is also a convergence with the definite potential to eliminate the 'black holes', if only enough political pressure could be brought to bear. Of course the map deliberately hides much of the complexity of online surveillance to make a political point. Online freedoms are, arguably, in reverse - and not just from more intensive government wiretapping spurred by the 'war on terror'. The right to explore cyberspace anonymously and communicate freely is being undermined by media corporations in their attempts to channel consumers and combat file sharing, along with criminals who are polluting virtual commons with offensive spam, phishing and malicious viruses.

Unsurprisingly, there is tendency in the quantitative analysis of global Internet to focus on technical and economic statistics - seen as solid, knowable data and relatively easily gathered, rather than 'fuzzy' human experience. (This has been highlighted by Cornford (1999) as a general problem in the statistical assessment of impacts of ICTs.) The basic epistemological problem in all the above approaches seeking generalisable mappings is that they explain little about people's real experience. Statistical world maps in this regard have an implicit tendency to dehumanise the world because they work best as simple stories of national averages, per capita scores and the rollout of governmental schemes. To broaden the understanding of the *peopling* of the global Internet, one must try to assess the rich, individual experiences of networking practices best gained through ethnographic case studies.

The work of anthropologists Miller and Slater (2000), examining how the Internet is variously adopted and adapted into everyday life of people in Trinidad, provides an authoritative exemplar of the benefits of exploring the local contingency of networking practice. Accordingly, they claim, "[s]ocial thought has gained little by attempting to generalize about 'cyberspace', 'the Internet', and 'virtuality'. It can gain hugely by producing material that will allow us to understand the very different universes of social and technical possibility that have developed around the Internet in, say, Trinidad versus Indonesia, or Britain versus India" (Miller and Slater 2000, 1).

In particular, most existing statistical approaches and mappings completely fail in their representation of the African experience of the Internet. The result, at present, leaves Africa largely as a blank, the 'dark continent' of old. The blankness on Western-centric 'top-down' statistical maps of the network society masks the fascinating richness and diversity of the Internet's percolation through Africa (e.g., see Barlow 1998; Hall 1998 for diverse examinations of the situation 'on the ground'). The need is for analysis not to demarcate the spaces of diffusion but to give voice to the places of adoption.

Given this sophistication is pretty much impossible to capture in conventional cartographic genres, in what ways are the statistical maps of Internet globalisation useful and how should they be interpreted politically? They seem to provide a conceptually simple - one might say simplistic - picture of the global geography of the Internet. Taken together they create a various cartographic stories of the extent of the diffusion of connectivity and access measured at the national scale. The maps, through the use of the most 'obvious' geoplitical form of nation state, make it is easy to assume that they provide a clear and straightforward geographic presentation of the data. This is certainly how they have been used (for example deployment of DOI map by the ITU). Yet, one must also recognise "that these depictions of network activity are embedded in unacknowledged and pernicious metageographies -- sign systems that organize geographical knowledge into visual schemes that seem straightforward, ... but which depend on historically - and politically - inflected misrepresentation of underlying material conditions." Harpold (1999, 5). A critical reading of them as actually revealing something of this metageography, that they actually 'truthful' maps of contemporary global power relations. As world maps and thematic maps from Victorian era can now be read as representations of Britain's imperial vision, so these maps can show the nature of contemporary economic neo-imperialism driven in part by the Internet.

5.9 Conclusion

This chapter has examined a range of different statistical maps of Internet globalisation in some detail and in conclusion I want to think about how they work in terms of positioning them into the four quadrant model of connotations outline in section 5.2. The conception uses to two linear dimensions of meaning ('difference' and 'complexity') to create a simple fourfold grid of possible categorises which best summarise the map, allowing for the fact that the nature of connotative meanings is partial, contextual and unstable so that any placement will always be approximate (Figure 5.20).

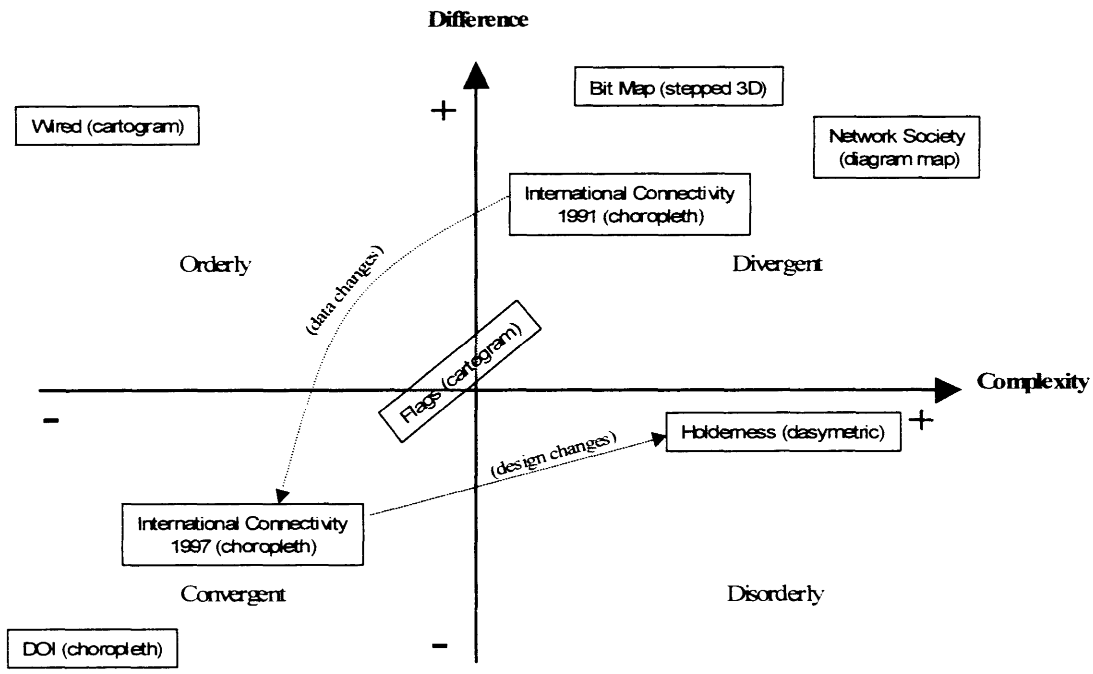

Figure 5.20: Positioning the sample statistical maps analysed in the fourfold grid of connotative meanings.

Despite having varying degree of denotative effectiveness, in the technical sense of intelligibly conveying patterns of variability between nations and difference within nations, it is important to remember that all these maps have important connotative meanings, and they are all products of particular people and institutions who are embedded in particular socio-political milieus and espouse their own agendas. It is also worth reiterating that it not possible politically to produce an unbiased map - they all remain selective and socially-produced representations. In many ways, their connotative messages are ambiguous and open to multiple readings, in that some highlight more strenuously the divisions in some respects, but, at the same time, also speak to the potential for convergence as well.

Given these limits, it is apparent that the eight different statistical maps examined occupy a range of positions in the fourfold grid, with slight majority tending towards convergent meanings in how they represented Internet globalisation. Considering each of the maps in turn, it seems useful to start with Antonio Scarponi's 'Internet Users World Map', which is represented by the box 'Flags (cartogram)' in Figure 5.20 and has been placed precariously balanced across the confluence of the two axis as it exhibits in a dichotomous fashion connotative meanings of both convergence and divergence in roughly equal measure. While the meanings of the flags are complex to interpret, the evident growth in the cartogram and the emergence of dominant national and supranational blocks suggests a consolidation of power, yet other elements are, at the same time, divergent in meaning with the multitude of different flags connoting a countervailing force of cultural diversity and potentially nationalist separatism.

The 'Digital Opportunity 2005/2006' map produced by the ITU is, arguably the most convergent in terms of connotations of difference and complexity. Overall, it projects a view of Internet globalisation that is strongly harmonious with commonalities between nations rather than wide differences. The degree of variance across the world is made to appear as gradual, almost natural, phases of change and there are no sharp breaks or unsettling complexity.

The 'Wired World Atlas' is a rectilinear cartogram which has been positioned high in the orderly quadrant because it presents a compelling vision of Internet globalisation that is at once simple in appearance but also highlights the differences between continents. The connotations of simplicity stem from the block shapes and the even transitions of colours but there is also a very unequal connotation created by the scale differences in block sizes across the world as a whole.

The 'Bit Map', with its distinctive pseudo three-dimensional stepped representation of the world, is similar in some respects to the connotative meanings of the 'Wired World Atlas' as it emphasises, using height and volume, the differences between regions of the world. The extent of divergence across the world can not be counteracted by the classification and colour scheme that work to reduce the perception of inequality. The overall feel of the pattern is much more intricate and disorganized than the Wired presentation, hence the placement of the 'Bit Map' in the divergent quadrant, scoring highly on both dimensions of difference and complexity.

Two versions of the 'International Connectivity' maps, one from near the beginning of Internet globalisation (1991) and then another from the height of the Internet boom (1997) were examined. The first map from 1991 suggests a fairly divergent and somewhat disorderly world, with some areas of high difference evident (adjacent countries in polar opposite categorises and obviously wide differences between continents). The sharp inequalities are emphasised by the discordant choice of colours that can not suggest anything but divergence. There is little symmetry to the patterns of highs and lows across the world and the extensive inequalities mean this map, in connotative, terms is located inside the divergent quadrant. At the end of the 'International Connectivity' series, the eleventh map produced by Landweber in 1997, arguably, connotes a quite different view of Internet globalisation. This map suggests a much more convergent world due to changes in the underlying data as so many countries reached the top class (full Internet connections), rather than modifications in the design and classification (which remain constant). Given these changes in underlying data mean most of the world is a uniform colour leaving only constrained pockets of 'failure', the map scores much lower on difference and complexity dimensions and is positioned firmly in the convergent quadrant. The arrow between the 1991 and 1997 'International Connectivity' maps boxes in Figure 5.20 illustrate the reasoning behind the significant switch in connotations.

The next map is the dasymetric reconfiguration of the 1996 'International Connectivity' map undertaken by Holderness to take account of variance in connection density within countries, particularly in the developing world. The changed design, in terms of doubling the number of classes displayed on the map and the willingness to represent subnational variation in the data, means that it is a much more complex and less certain view of Internet globalisation. The impression is of a world much more divided, with only spots of high connectivity in many parts of the Global South. Given these characteristics this map should be placed connotatively in the opposite quadrant to its originator because it is fundamentally a disorderly representation of the world. The arrow between the two maps in Figure 5.20 illustrates that they map essentially the same data but the impact of classification and design changes has altered the connotative meanings.

The final map to classify into the fourfold grid is the 1997 'Network Society Map' hybrid diagram map, which has a clearly Eurocentric bias and visually emphasises the very partial distribution of 'network society' status across the world. The use of the diagrammatic targets plotted onto countries added to the complexity of patterns displayed and suggested multiple processes at work and little coherence in the narrative of network society diffusion. The design of the target graphics themselves also emphasises the incompleteness of the network society 'project' for most countries outside the core rather than demonstrating positive fullness. The many empty targets speaks to failure rather than success. Given these characteristics the dominant connotative meaning for the 'Network Society Map' is one of divergent world.

Chapter Six

Marketing Maps of Internet Networks

> The advertiser generally uses the map both to enlighten and to persuade and only rarely to distort. The map is often the quickest, clearest, and most neatly organised method of conveying a geographical idea in advertising.
>
> -- Douglas K. Fleming and Richard Roth, *Place in Advertising*, 1991.

6.1 Introduction

The focus of analysis in this chapter are marketing maps used in the commercial promotion of Internet infrastructure, particularly during the phase of rapid growth in the second half of the 1990s through a case study of WorldCom. A large number of maps of Internet infrastructures have been produced by commercial network operators for the purposes of marketing services and as an element in their corporate branding strategies. As such, they are the latest incarnation of a long lineage of marketing maps used to promote communications networks, including railways, highways and the airways. This genre of mapping is interesting theoretically as it drops the ethic of cartographic independence by serving an overt commercial purpose, namely to attract prospective customers and investors in what are often highly competitive business environments. The maps created seek to communicate persuasively to potential customers and investors the benefits of using the network operators' services above another company by highlighting key aspects of their infrastructure, including its geographic extent, the range of important places connected and its capacity.

The analysis in this chapter is structured in four distinct parts: it begins by discussing the nature of marketing maps in general terms, considering how cartographic rhetoric can be employed in commercial promotion strategies for a variety of networks. The second part of the chapter is an overview analysis of the extent of marketing map usage to promote Internet infrastructure based on data from a content study of the websites of the fifty most important network providers. In the third part a framework of cartographic design strategies is developed to analyse the rhetorical power of the network marketing maps. This framework is then applied to examine in the detail global scale network marketing maps deployed by five of the largest telecommunications corporations. The forth and final part of the chapter analyses a time series of network marketing maps produced by WorldCom, a corporation that dominated Internet infrastructure provision through much of the late 1990s before going bankrupt in 2002. The analysis uses the same framework of cartographic design strategies as in the previous section, along with other contextual business data and interview material from the manager responsible for map production, to understand how the marketing maps of one corporation evolved over time, considering the extent to which design modification improved the rhetorical capacity of the maps to match WorldCom's global ambitions. The concluding discussion considers the role of network marketing maps in the promulgation of unrealistic views of Internet growth, which in the late 1990s fuelled a disastrous speculative bubble of investment in infrastructure that lost shareholders billions when many networking companies went bankrupt in 2002.

6.2 Maps for marketing

Given the ways that maps can be made to 'lie', it is perhaps not surprising that they are a commonly used visual trope in consumer advertising, corporate marketing and place promotion. As has been well noted, all maps are selective in what they show because they take a particular viewing position, in that they are essentially *selling* a viewpoint on space that serves certain interests. And like advertising, the best maps work when the viewers do not really feel they are being sold a selective view.

In scholarly discussion of the forms and purposes of Western cartography it is frequently asserted that a distinct genre of propaganda mapping can be usefully discerned. Such maps are categorised separately from 'normal' cartography on the basis that their goal is consciously political and their design is deliberately and maliciously manipulated to present views of space that advance one particular message above all others. Fundamentally, maps are propagandist in nature when they wilfully deceive people to change their behaviour. Yet, attempting to draw a sharp and practicable distinction between propaganda maps and other supposedly 'objective' cartography is obviously a problematic task. As Pickles (2004a, 39) points out, "notions of propaganda are ... centred on an unexamined boundary between 'truth' and 'falsity', an unstable boundary at best." In fact all maps have persuasive and deceptive qualities – and a part of the practice of 'scientific' cartography is to police the norms on acceptable deception (through, for example, the recommendations given in textbooks and best practice guides, along with the criticism and gate-keeping work of journal editors and reviewers.)

The most evident propaganda cartography is the mapping used by the state in asserting claims for the territorial naturalness of the nation, for the geographic right of territorial expansion or to exaggerate foreign threats (cf. Biggs 1999; Burnett 1985; Herb 1997). Propaganda maps produced for mass consumption in times of war offer particularly egregious examples of cartographic artifice, often overlaid with crude racist symbolism, to generate fear of the enemy and engender greater efforts from citizens (see Monmonier 1996, chapter seven; Tyner 1982). More subtle and insidious ethnocentric propaganda is said to pervade the world maps of many national atlases (cf. Fremlin and Sebert 1972; Kent 1986). The devices of cartographic centring and biased size distortions, fostered through projection choice, are used to create an advantageous sense of national superiority that seems to be geographically ordained (Henrikson 1994). Overtly propagandist mappings are not the sole preserve of government, of course, and in recent decades non-state actors have created consciously political cartographies in counter-hegemonic discourses opposing, for example, nuclear weapons (cf. Burnett 1985). While commercial marketing maps, as a form of propaganda in support of capitalist accumulation, carefully use the pretensions of objectivity in selling a respectable representation space.

Clearly, decoding the propagandist connotations given off by maps depends to a great degree on the discourses in which they are used. When the discourse moves away from informing to *influencing* the reader, the map is evoked as an intentional means to change behaviour in one particular direction, resulting in what Tyner (1982) usefully terms persuasive cartography. It is evident that the growth in persuasive cartography in the twentieth century has seen a shift in emphasis from politically-motivated propaganda mapping to profit-driven promotional cartography. The shift is evident in the use of maps in consumer adverts that seek to channel customers to the benefit of private capital rather than national interests. "Whereas maps were once used to expand nation building they now build commercial empires that, in a very real sense, are eclipsing the nation-state in importance" (Francaviglia 2005, 11). Yet, the effectiveness of maps in the service of commercial promotion has been, surprisingly, little examined in the cartographic literature, with only sporadic coverage since the Second World War (e.g., Harrison 1953; McDermott 1969; Monmonier 1996; Schulten 2001). Growth in the commercial use of maps has been significant, particularly as new means of cartographic production enabled a much wider range of more attractive graphic representations (e.g., Richard Edes Harrison's celebrated hemispheric map views), some of which were the direct result of new technologies created in the Second World War and subsequent Cold War arms race (cf. Cloud 2002).

6.2.1 Advertising visual rhetoric

At one level, advertising works semiotically through iconic images that show what the product or service looks like and indexical images that show how it can be used - car advertisements being a good exemplar, with close-up views of the form of the vehicle and then seductive shots of it being driven. Obviously, maps can serve indexically as a good way to show a complex, space-extensive product such as a transportation network to potential customers, the archetypal case being the airline route map found in nearly every in-flight magazine (discussed below).

However, much modern advertising rhetoric is about creating a brand identity rather than demonstrating specific products and how they are used. Marketing is about generating a desirable image - the brand - that consumers will aspire to be part of. People *desire* goods and services from the brand in the hope that the positive cache associated with brand is transferred onto them. Consequently, rhetorical messages in branding tend to be more subtle than 'straight' product advertising, (for example lifestyle imagery used in establishing the brand values of car manufacturers and their models - young and fast, luxury and business, families and flexibility, and so on). Even though there is resistance and cynicism from many consumers to these lifestyle marketing efforts, powerful brands, particularly those with global appeal, are recognised as hugely valuable assets. For some businesses, the building of the brand is arguably their primary activity as the products by themselves are largely indistinguishable (e.g., the drinks industry). Many multinational companies spend hundreds of millions developing a brand identity and marketing it through numerous media channels. The most successful have become global icons recognisable virtually everywhere. Indeed, these branding strategies themselves have come to be seen as a defining element in contemporary globalisation and threatening in terms of cultural homogenisation (Klein 2000).

The production of brand imagery in a marketing campaign relies much more heavily on symbolic representations, rather than iconic or indexical semiotic forms. Commonly the product or service is not shown at all - it does not really need to be. Instead, the goal is to conjure up the right mood using symbolic visual forms that resonate with readers through base human instinct, ingrained cultural conventions or positive associations (e.g., celebrity endorsement or sporting sponsorship). Maps, when used adeptly, can have powerful symbolic qualities, able to exude a multiplicity of connoting moods required for effective brand marketing. At one level, a familiar map can symbolise a sense of pride in territory, taping into national identities and reassuring feelings of hearth and home, but they can also be used to connote messages of adventure, exploration and the exoticism of distant lands. Antiquarian-looking maps, on the other hand, can be used to suggest endurance, authenticity and traditional wisdom; while sweeping satellite views overlaid with glowing grids radiate a modernist sense of techno-power and transcendence over nature.

In corporate brand advertising of 'hi-tech' firms, maps are a common visual trope used purposefully to tap into the cartographic fetish of expansionism and the pseudo-militarist aura of command and control over territory (see Goldman *et al.* 2003). Corporate marketing designs mesh with business desires to "wrap the world in complexes of arrows, networks and cages to represent their own 'global' presence" (De Cock *et al.* 2001, 217). World maps, map-like overhead satellite views and Earth globes are now so thoroughly ingrained visually in globalist business discourses that their use can easily tip into cliché. The image of the Earth, in particular, is an enormously powerful symbol that can connote myriad different meanings and has been exploited by a wide range of interests (cf. Cosgrove 1994; Edsall 2007; also chapter four).

Besides globes, a panoply of other geographic imagery is used for its symbolic power. These can include expansive landscape views of the countryside displayed on the threshold between map and picture, dramatic panoramic cityscapes, typically represented at night-time as vistas of lights, and increasingly popular use of high-resolution aerial photography. Cartograms and map-like pictorial graphics are also common in marketing, often employing elements of fantasy or whimsical humour to produce a positive rhetorical effect (see Edsall 2007; Holmes 1991; McDermott 1969 for examples). Spatial rhetoric can even be conveyed simply from territorial outlines, as they are proven to be "a highly recognizable shape that cannot be confused with anything else" (Francaviglia 2005, 5).

6.2.2 Marketing maps for transportation networks

The use of marketing maps in the establishment of the brand identity of commercial transportation networks has a long lineage and one of direct relevance to understanding the commercial promotion of Internet infrastructure. As Fleming and Roth (1991, 288-289) note, "[r]elative locations, distances, types of itineraries, transit times, and costs of transit are factors of significance in the advertising of railroad, ocean, and airline services." All these factors can usefully and persuasively be visualised in cartographic form[1]. Showing the geographic structure of routes offered is an especially powerful selling point and one that can best be conveyed semiotically through network maps and diagrams. This is well demonstrated in nineteenth century railroad cartography, for example.

The growth in railroads in the United States from the 1850s, especially during the speculative building boom following generous land grants from the government, led to fierce competition between companies on routes between major metropolitan centres. High quality network maps were a significant element in competitive marketing strategies (cf. Modelski 1984; Musich 2006). Initially derived from construction surveys and engineering plans, the output became ever more presentational in design and persuasive in purpose, such that "manipulating scale, area, and paths of railroads became common practice in advertising maps of the 1870s and early 1880s and in railroad timetable maps" (Modelski 1984, 4). Besides long-distance railways, the growth of mass transit subways, trams and buses at the end of the nineteenth and beginning of the twentieth century in large cites required a new

[1] For typical examples, see the collection of transportation and communication maps from the nineteenth century provided by the maps division of the U.S. Library of Congress, <http://lcweb2.loc.gov/ammem/gmdhtml/trnshome.html>.

mapping idiom to inform passengers, and also to promote new ridership. The development of complex metropolitan networks and the need to forge a public identity for an integrated system gave rise to one of the celebrated maps of the twentieth century, the London Underground 'diagram' (Garland 1994).

Harry Beck's supremely successful Tube map not only made a chaotic mass of lines under London into a legible system, it also created a powerful visual-cognitive template of the spatial layout of London in the minds of many visitors and residents. The cartographic design, drawing on ideas from electrical wiring diagrams, pioneered a new genre of schematic subway maps, which sacrificed locational accuracy for topological clarity and has been widely copied across the world (cf. Avelar and Hurni 2006; Ovenden 2003). The Tube map also established itself as marketing symbol par excellence for the Underground, and now enjoys symbolic power world-wide as a marque of London and quirky Englishness.

In promoting the network in the way it did, the Tube map also played an important part in promoting the actual form of London's urban growth (Hadlaw 2003). Extending the simplification and generalisation of cartographic practice to the extreme, Beck completely denied the twists and turns of topography by straightening route lines; stations became uniformly spaced, and - most (in)famously - differential distance scales were applied across the map to expand the crowded centre and greatly shrink the periphery. The result was to *sell* a selective spatial layout of London, a layout that is cartographically *marketing* a much more compact, orderly and accessible city than really exists. The remote suburbs, in particular, only look to be a short distance from the centre of town in Beck's vision of London, when in fact they are a rather long ride away.

Another noteworthy example of persuasive network cartography was the role of route maps in selling the desirability of automobile travel in the U.S. in the 1930s. Detailed analysis by Ristow (1964) and Akerman (1993, 2002) has ably decoded the marketing rhetoric in the production of these widely used route maps, directed and subsidised by oil companies and motoring clubs[2]. The free 'gas map,' Akerman (2002, 187)

[2] The Petrol Maps website curated by Ian Byrne provides a comprehensive catalogue of examples for Britain, <www.ianbyrne.free-online.co.uk>.

observes, "promoted specific brands by associating them with positive social aspects of automobile travel and good customer service". Most state governments also produced official highway maps as a potent form of tourist promotion, with selected historic and scenic places of interest prominently marked. The manipulative techniques in service to marketing included "representing highways in thick, clean lines emphasizing connected populated places and cross-routes" (Akerman 1993, 16) along with clear route identification through numbering schemes. Importantly, the promotional elements did not in themselves diminish the need for clear, reliable route information to facilitate navigation - although "railroads ... were generally omitted" (Akerman 1993, 16), which conveniently worked to 'silence' the competition to the automobile. Similar techniques continue to be used to help drivers and sell road travel in the latest, advertising-supported, interactive route planning services available on the Web. Today, the extent to which car culture dominates in most developed countries means that the persuasive road rhetoric underlying general reference mapping is masked and rendered unquestionable (see Wood 1992, chapter four).

In addition to rail and road, the most obvious application of the marketing maps is the promotional cartography of the airlines[3]. Virtually all glossy in-flight magazines contain a route map that informs and above all persuades passengers of the space-transcending power of the airline. The map's "rationale seems to be to create an impression of the airlines entangling, even appropriating, the world in their own webs of commercial influence" (Thurlow and Jaworski 2003, 586-588). The route maps have been around since the start of commercial aviation as an obvious - and from a marketing perspective, absolutely intrinsic - way to make intangible schedules of flight times and lists of destinations into a coherent, believable and *real* network, capable of carrying people quickly, reliably and safely. An interesting feature of airline route mapping over the years has been its willingness to experiment design-wise, particularly with unconventional projections as a means to get the optimal promotional look for the map. Cartographic manipulation has been put to the service of corporate centricism, necessary to position the airline's hub of operations at the central point of the map view, and to connote a convincing visual appearance of the

[3] The Airchive curated by Chris Sloan presents an impressive array of route maps, <www.airchive.org>.

desirability of its routes by making them look to be the shortest or most direct (Fleming 1984). In the last decade, the printed route maps in in-flight magazines have also been significantly augmented by the airshow moving map provided as one of the entertainment television channels on many long-haul flights. This map dynamically updates the position of the plane to inform passengers of the progress of the flight, but it is also subtly promotes a particular sense of the air travel experience through a privileging, God's-eye, view of the world for passengers.

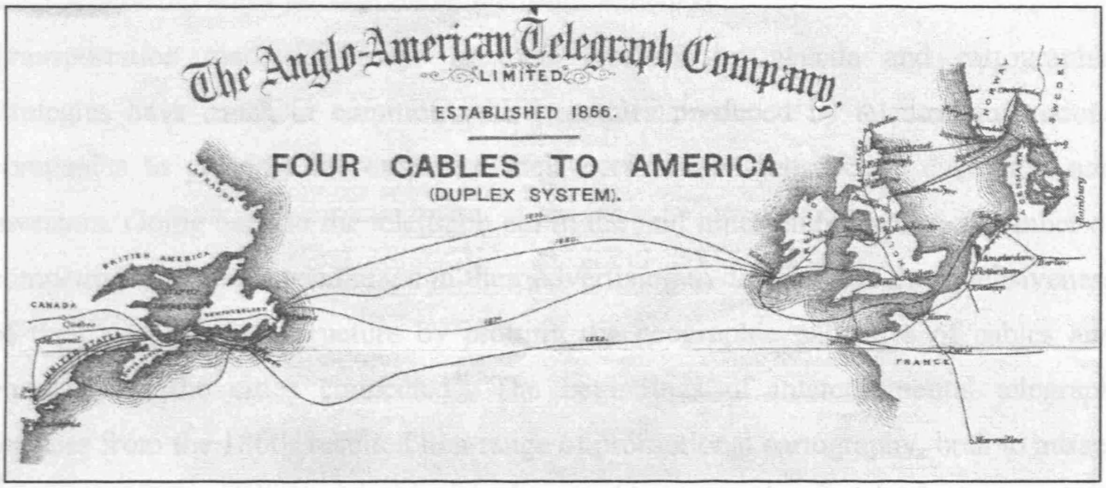

Figure 6.1: Network marketing map from the telegraph era. (Source: Bill Burns, <www.atlantic-cable.com/Maps/index.htm>.)

Figure 6.2: An attractive azimuthal projection map of the world produced to market the globe spanning Cable & Wireless telecommunications network in 1945. (Source: Cable & Wireless Archives, Porthcurno, Cornwall, <www.porthcurno.org.uk/>.)

6.2.3 Marketing maps for telecommunications networks

Transportation marketing maps in their profit-driven agenda and cartographic strategies have much in common with examples produced by telecommunications companies to promote the extent of their networks to prospective customers and investors. Going back to the telegraph era in the mid nineteenth century, a number of competing companies used maps in their advertising to demonstrate the extensiveness of their network infrastructure by plotting the geographic pathways of cables and emphasising the cities connected[4]. The beginnings of intercontinental telegraph services from the 1860s resulted in a range of promotional cartography, both to attract investors and to celebrate the success of new cable connections[5]. A typical example is the map from the Anglo-American Telegraph Company (Figure 6.1 above). In many cases, these ambitious and expensive engineering schemes were initially intimately bound to the needs of imperial communications. Servicing the telecommunications needs of the British Empire, for example, was the responsibility of the Cable & Wireless company linking the territory on the 'red routes' and becoming one of the largest operators of networks across the world by the middle of the twentieth century (cf. Barty-King 1979). The company commissioned designer MacDonald Gill to produce the 'Great Circle Map' (Figure 6.2 above), a particularly refined example of telecommunications marketing genre, with its promotional cartouches showing scenes of building the network infrastructure and how it operated. The map also provides a seminal example of projecting the company (and in an imperial sense, the British nation) at the centre of the map, with cable route lines radiating outwards from Britain to connect distant lands.

The task of network mapping for telecommunications companies is in some respects harder than for transportation, but at the same time more important for marketing. As discussed in chapter four, the invisibility and intangibility of the infrastructures for telecommunication, as opposed to those for physical movement, mean there is little for people to see and feel. The telegraph, the telephone and the Internet lack the iconic

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[4] A range of examples for North America can be found online in the David Rumsey map collection <www.davidrumsey.com> and the U.S. Library of Congress's collection <http://lcweb2.loc.gov/ammem/gmdhtml/trnshome.html>.

[5] Examples maps and memorabilia associated with these engineering feats are available on Bill Burns' 'History of the Atlantic Cable & Submarine Telegraphy' website, <http://atlantic-cable.com>.

architectures of railway viaducts, wide highways carving through the landscape and monumental modernist airport terminals that can be exploited for advertising imagery. (The prominence of BT Tower in central London is an exception to the rule and only reinforces the great extent of the invisibility of telecommunications infrastructure). Furthermore, the most conspicuous visible element in telecommunications networks, the telephone handset, has none of the dramatic visuality of fast cars, thundering trains and soaring jetliners.

Besides the invisibility of infrastructure, telecommunications networks are also intangible from the consumer experience perspective (see also chapter four). In transportation, the friction of distance can be readily turned into fictions of experience by the marketers. Passengers and drivers have innate, physical knowledge of transportation networks through the journey. Positive elements of this physicality - the smoothness of the ride of the new car, the relaxing comfort of wider seats on planes and so on - is commonly exploited in promotional narrative that attempt to positively connect customers to brands[6]. Telecommunications, in their inherent virtuality, are completely lacking such experiential customer knowledge. The *lack* of human kinaesthetic involvement defines *tele*-communications. Telephones and the Internet provide customers with mere interfaces to the network, through physical devices like the phone handset and computer screens, not experience of the network itself. No knowledge of the network structure and physical construction is gained from browsing the Web, for example - it gives off little physical sensation, except perhaps the sense of delay when waiting to connect or the odd bout of frustration when it fails temporarily.

Marketing telecommunications, therefore, tend to construct its own symbolic imagery in the form of route maps, in part to compensate for the lack of other iconography and direct customer experience that can be more easily exploited (see the discussion in chapter four of major types of spatial metaphors used to represent Internet infrastructure). Route maps of telecommunication networks, while of no practical value for navigation, construct a sense of tangibility, a kind of second-hand

[6] Of course, the all too common mismatch between customer experience and the projected images of marketers is the basis for much contemporary cynicism about corporations.

experience of the network to compensate for the lack of directly observable activity. This was particularly so when the technologies were new and customers and investors needed evidence of what they looked like and how they worked. This has been repeated with the development of the Internet from 1990s onwards when maps became a useful tool for making a novel, unusual and unproven technology seem real.

6.3 Internet marketing maps

In many respects promotional Internet network maps as a genre can be traced back to those produced to document the growing extent of ARPANET from the early 1970s through to the late 1980s. In terms of their cartographic design there is little to choose between the maps produced by BBN[7] to virtually witness the logical structure of links and hubs of ARPANET and the contemporary Internet marketing maps detailed in the following section.

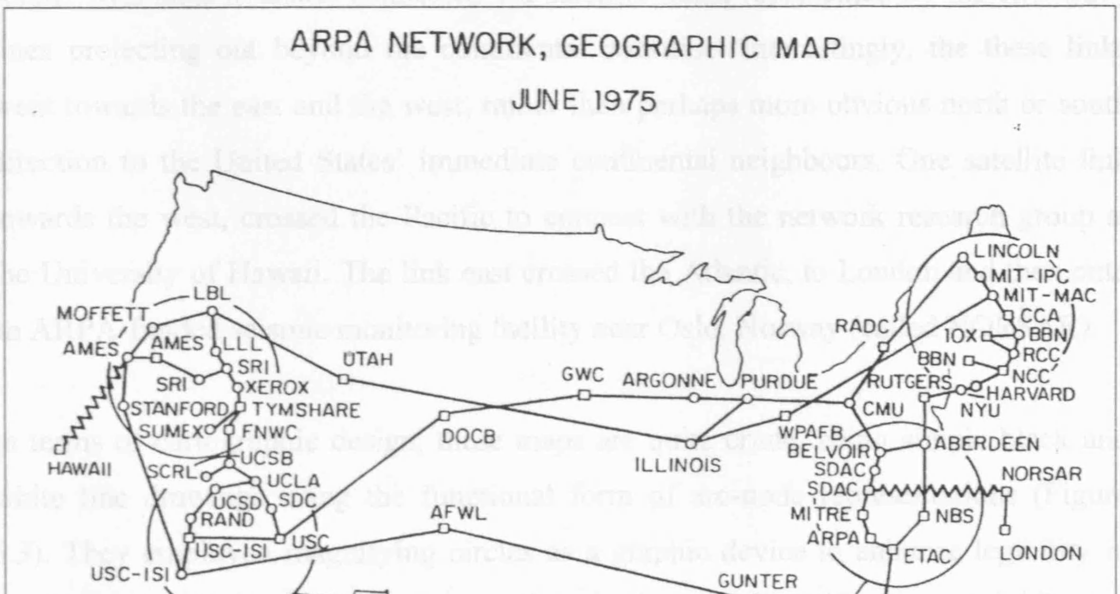

Figure 6.3: ARPANET network map created by Bob Brooks and the BBN graphic design department to promoted the growth of the infrastructure. (Source: scanned from Heart *et al.* 1978.)

[7] The private company contracted by the U.S. government to design, build and maintain the network.

ARPANET pioneered wide-area computer networking in the U.S. and laid much of the foundations of the Internet in terms of both the technical infrastructure and social practices of internetworking (cf. Abbate 1999; Hafner and Lyon 1996). A series maps of ARPANET were created at regular intervals throughout its operation to document its network structure (e.g., Figure 6.3). (Many maps have survived in published records, reports and scholarly articles, e.g., CCR (1990) and Heart *et al.* (1978)). It is important to note that these maps show the ARPANET at the level of data linkages (termed 'level 2' in terms of the hierarchical layer model of communications protocols). They do not plot the actual geographic routes of the cables (so called 'level 1' facilities). While the nodes are relatively accurately positioned, the paths are merely relational, designating a link between sites. Hence the acceptability of generalising transmission paths between nodes to straight lines in the maps. It is also apparent from the maps that ARPANET was, tentatively at least, international in scope, with sites overseas connected via satellite links, represented by the two wavy lines projecting out beyond the continental coastline. Interestingly, the these links went towards the east and the west, rather than perhaps more obvious north or south direction to the United States' immediate continental neighbours. One satellite link towards the west, crossed the Pacific to connect with the network research group at the University of Hawaii. The link east crossed the Atlantic, to London and then onto an ARPA-funded seismic monitoring facility near Oslo, Norway (called NORSAR).

In terms of cartographic design, these maps are quite crude, being simple black and white line drawings using the functional form of arc-node representations (Figure 6.3). They employed magnifying circles as a graphic device to enhance legibility in the four core ARPANET regions in northern and southern California, and the Boston and Washington DC. This scale distortion makes the maps look fuller than they are. In reality, many sites were clustered geographically (e.g., the sites in the Washington DC area were all within a few miles of each other).

The presentation of the territorial base itself in these marketing maps of ARPANET as an empty canvas is also noteworthy. The U.S. is represented by a simple border line which has the effect of creating an inert container, an archetypal *terra nullius*, ready to be filled with infrastructure and remade into a modern networked space. Indeed, for the engineers involved, the ability to draw the network on a blank map parallels the unencumbered construction of the infrastructure itself: "the ARPANET did not have to interconnect with other existing and/or decrepit communications systems; it was possible to establish … standards *de novo*, in the best ways that could be devised" (Heart *et al.* 1978, III-111). Fitting into the U.S. tradition of Manifest Destiny, ARPANET could literally be mapped out over a blank landscape.

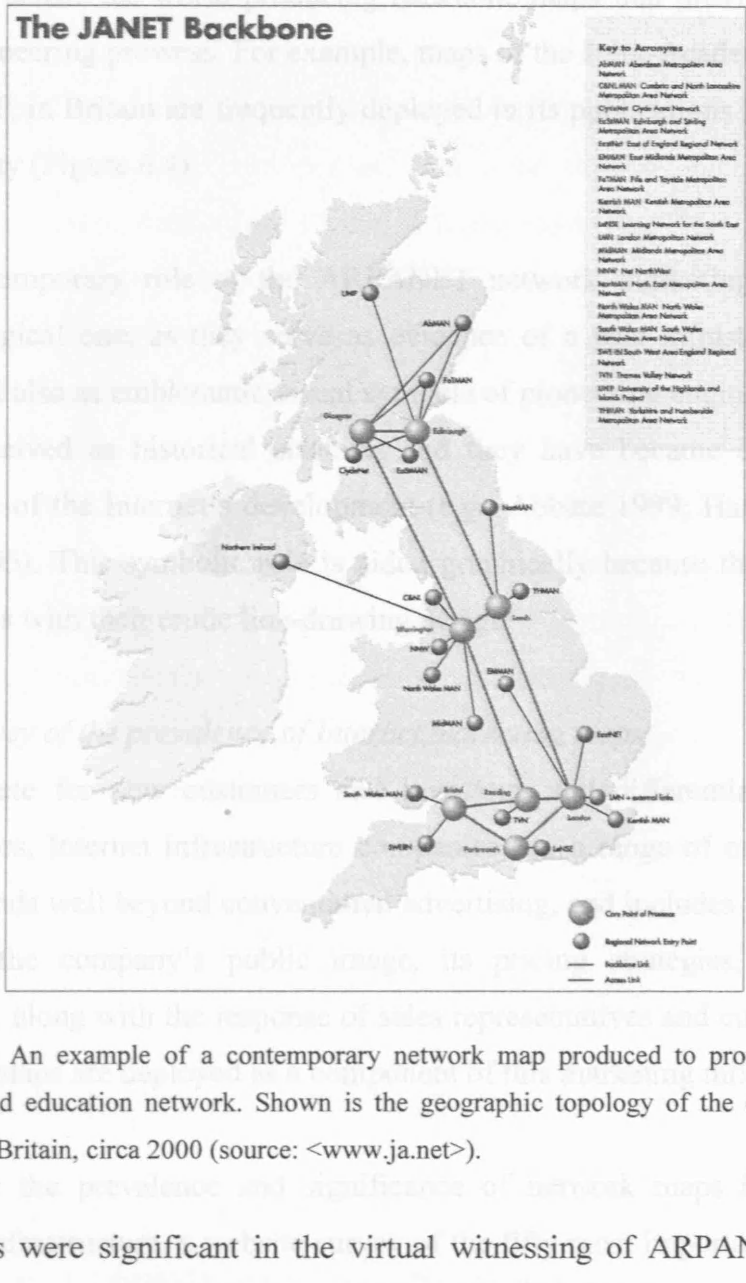

Figure 6.4: An example of a contemporary network map produced to promote a non-commercial research and education network. Shown is the geographic topology of the core of the SuperJanet3 network in Britain, circa 2000 (source: <www.ja.net>).

The maps were significant in the virtual witnessing of ARPANET, supporting the 'matter of fact' of novel packet-switching computer networking technology[8].

[8] One element of this was to win over traditional telecommunications engineering, which is based on the circuit-switching concept. This debate continued for next two decades. Today packet-switching has won out, as voice telephony is being rapidly being absorbed to become just another service running on IP networks.

ARPANET maps worked as a credible form of visual proof of, firstly, the material existence of a network that was beyond the limits of human vision and, secondly, the superiority of the engineering by showing a network that was dominant in size and spanning the nation. This kind of information dissemination and promotional 'pride' role for technical network maps, established as a distinct genre of cartographic discourse by ARPANET, continues today with contemporary research and education networks across the world producing backbone maps that provide virtual witness to their engineering prowess. For example, maps of the Joint-Academic Network, known as JANET, in Britain are frequently deployed in its publications for the technical user community (Figure 6.4).

The contemporary role of the ARPANET network marketing maps is really an archaeological one, as they serve as evidence of a past infrastructure that no long exists and also as emblematic visual symbols of pioneering engineering. The maps are now perceived as historical artefacts and they have became easily packaged into narratives of the Internet's development (e.g., Abbate 1999; Hafner and Lyon 1996; Salus 1995). This symbolic role is aided graphically because they easily connote as 'old' maps with their crude line-drawing design.

6.3.1 Survey of the prevalence of Internet marketing maps

To compete for new customers and investors, and differentiate themselves from competitors, Internet infrastructure companies use a range of marketing techniques. This extends well beyond conventional advertising, and includes the overall 'look and feel' of the company's public image, its pricing strategies, special offers and discounts, along with the response of sales representatives and customer service staff. Network maps are deployed as a component of this marketing mix of activities.

To gauge the prevalence and significance of network maps in the marketing of Internet infrastructure, a website survey of the fifty most important corporations[9] was conducted in August 2007. A subsidiary aim of the survey was to evaluate the

[9] Ranking of corporation by importance used to select the sample for the survey was based their capacity to route traffic across the Internet. This was determined by a measure of degrees of connectivity (given in column two in Table 6.1) to other corporations in an adjacency matrix calculated by active surveying of Internet topology undertaken by the Cooperative Association for Internet Data Analysis. Further details and the full ranking data available from <http://as-rank.caida.org/>.

appearance of any network marketing maps present in terms of their geographic scale and user functionality. The survey methodology involved the identification of the main corporate website used to promote networking services[10] and then a thorough manual search was conducted to determine the presence of any network maps; results were recorded in a spreadsheet and a digital copy all maps located was taken (where interactive and dynamic maps were present representative screenshots were taken and stored).

The tabulated results for the fifty corporate websites surveyed, summarised in Table 6.1, showed that seventy-six percent had some form of network marketing map present. (A comprehensive set of the different marketing maps discovered from the survey is provided in appendix three.) In some regards, it seems that having a infrastructure map available is seen as necessary in itself, irrespective of what the map shows. For marketing bravado, it is the ability to produce such maps that symbolises the company as a 'serious' player in the Internet infrastructure industry. A useful parallel can be drawn here to the airline industry, where Thurlow and Jaworski (2003, 586, original emphasis) note in their study of promotional in-flight magazines: "it is not so much what is *in* the magazines which is important, as the fact that the airlines have a magazine clearly identified by its ascription to a range of generic 'in-flight magazine' features. .... it appears that the in-flight magazine is a textual practice which marks an international airline as an 'international airline' - evidenced most obviously by its ubiquity."

[10] Note, this was not always the primary consumer-facing website. For example, BT has a dedicated website for its network infrastructure (www.btglobalservices.com) that is quite separate from its for domestic customers (www.bt.com).

Table 6.1: Use of network marketing maps on the websites of the top fifty Internet infrastructure operators, August 2007. (Source: Author survey. Ranked list of corporations provided by Cooperative Association for Internet Data and Analysis, <www.caida.org>.)

					Map Scales				Map Functionality					
Rank	Degree	Corporation (headquarter location)	Website surveyed	Map presence and prominence	Global	Regional	National	Metropolitan	zoom / pan	Layer selection	Query / search	Dynamic data	Date indicator	Topology diagrams
1	3,008	Verizon Business (USA)	www.verizonbusiness.com											
2	2,079	AT&T WorldNet (USA)	www.att.com											
3	1,689	Sprint (USA)	www.sprint.net											
4	1,660	Cogent Communications (USA)	www.cogentco.com											
5	1,436	Level 3 Communications (USA)	www.level3.com											
6	1,260	Qwest (USA)	www.qwest.com											
7	967	Global Crossing (USA)	www.globalcrossing.com											
8	934	Time Warner Telecom (USA)	www.twtelecom.com											
10	680	Hurricane Electric (USA)	www.he.net											
11	564	Abovenet Communications (USA)	www.above.net											
12	528	Verio (USA)	www.verio.com											
13	521	XO Communications (USA)	www.xo.com											
14	499	Savvis (USA)	www.savvis.net											
15	482	Telia Sonera (SE)	www.teliasoneraic.com											
16	466	COLT Telecommunications (NL)	www.colt.net											

17	464	LambdaNet (DE)	www.lambdanet.net
18	432	VSNL International (CA)	www.vsnlinternational.com
19	406	Deutsche Telekom (DE)	www.deutschetelekom.com
20	394	Swisscom (CH)	www.swisscom.com
21	392	Tiscali International Network (DE)	www.tiscali.net
23	341	WV Fiber (USA)	www.wvfiber.com
24	324	KPN (NL)	www.kpn.com
25	323	LG DACOM (KR)	www.lgdacom.net *
26	315	Interoute Communications (UK)	www.interoute.com
27	306	Korea Telecom (KR)	www.kt.co.kr *
28	304	Bell Canada (CA)	www.bell.ca
29	298	PCCW (USA)	www.pccwglobal.com
30	291	KDDI Corporation (JP)	www.kddi.com
31	248	TransTeleCom (RU)	www.transtk.ru
32	239	Cable & Wireless (UK)	www.cw.com
33	227	Net Access Corporation (USA)	www.nac.net
34	216	IIJ Internet Initiative Japan (JP)	www.iij.ad.jp
35	216	Asia Netcom (CN)	www.asianetcom.com
37	205	Golden Telecom (RU)	www.goldentelecom.ru *
38	195	British Telecommunications (UK)	www.btglobalservices.com
39	194	REACH (HK)	www.reach.com
40	193	Port80 (SE)	www.rixport80.se *
41	191	PIPEX (UK)	www.pipex.net
42	185	Internap Network Services (USA)	www.internap.com
43	183	Yipes Communications (USA)	www.yipes.com

44	178	New Edge Networks (USA)	www.newedgenetworks.com											
45	178	Romania Data Systems (RO)	www.rdsnet.ro *											
46	175	RTComm (RU)	www.rtcomm.ru											
47	174	Cablevision (USA)	www.cablevision.com											
49	167	France Telecom (FR)	www.francetelecom.com											
50	162	Cox Communications (USA)	www.cox.com											
51	161	GTS Energis (PL)	www.gtsce.com											
52	156	Flag Telecom (UK)	www.flagtelecom.com											
53	153	SingTel (SG)	www.singtel.com											
54	143	Integra Telecom (USA)	www.integratelecom.com											

* Indicates non-English language website

Note: The following entries from the CAIDA list were excluded because the corporation no longer exists:
9 SBC Internet Services (USA)
22 Broadwing Communications (USA)
36 WilTel Communications (USA)
48 Adelphia Business Solutions (USA)

Legend
= Network maps featured prominently on homepage
= Network maps featured prominently on product pages
= Network maps can be found by browsing around
= Network maps are hidden, found by keyword search
= No network maps evident on corporate website

6.3.1.1 Website sample

The fifty corporations surveyed provide a cross-section of commercial providers of Internet infrastructure services. Some of these are well-known telecommunications companies which offer consumer phone services (such as AT&T and British Telecom), whereas others specialise in Internet infrastructure services (e.g., Interoute Communications). Even though this is the top fifty ranked corporations, it should be noted they do vary in the size and scale of their operations, ranging from global scale corporation with transcontinental infrastructures, millions of customers and many billions in revenues (e.g., Verizon and Deutsche Telekom), down to smaller, niche operators serving particular regional or national markets (e.g., GTS Energis in central Europe). The degree column in Figure 6.1 indicates the scale range of connectivity across the sample. From the original rank list it was found during the survey process that four corporations no longer existed as distinct businesses[11]. It was decided to exclude these four corporations and to substitute the next four highest ranked corporations to maintain a consistent sample size. As a consequence of this, the numbering in the rank column in Table 6.1 goes down to fifty-four and has gaps at nine, twenty-two, thirty-six and forty-eight indicating the excluded records. Another caveat with five of the corporations in the sample was the unavailability of their corporate website in English which hindered an in-depth search (these are indicated in Table 6.1, column 4).

Geographically, the sample is weighted to U.S.-based corporations (twenty-two out fifty surveyed); of the other twenty-eight corporations, the majority were headquartered in Europe (nineteen) and southeast Asia (seven). There were no corporations headquartered in Africa, Oceania or South America in the survey. This distribution is unsurprising and reflects the uneven geography of global telecommunications and the political economy of Internet infrastructure which is dominated by U.S. based corporations.

[11] These were: SBC Internet Services (ranked 9th), Broadwing Communications (ranked 22nd), WilTel Communications (ranked 36th), Adelphia Business Solutions (ranked 48th). They were all U.S. based and have either merged with or been taken over by corporations.

6.3.1.2 Website survey results: map prevalence and prominence

The survey found network maps present on thirty-eight out of fifty corporate websites examined (seventy-six percent). This basic count of presence demonstrates that maps are widely employed and clearly deemed worthwhile to produce and display for marketing purposes. Looking at the results for presence of maps in more detail (see Table 6.1, column five), it is apparent that the higher ranked corporations are more likely to have marketing maps. The top quartile of most important corporations, in terms of degree of Internet connectivity, all had some form of network marketing map deployed on their websites. In the bottom quartile, over a third (thirty-eight percent) of corporations had no network maps visible on their websites.

Beyond simple presence/absence, the website survey assessed the prominence of network maps on the websites and by implication the weight attached to them in marketing terms. Prominence was quantified through how easy they were to find and how highly positioned they were in the website page hierarchy. Corporation's use of maps was then coded into a five-level categorisation (represented by different hatching styles in Table 6.1, column five):

1. Network maps prominent, featured on or directly linked from the homepage,
2. Network maps featured prominently on secondary product pages,
3. Network maps can be found by browsing around subsidiary pages,
4. Network maps are hidden away, found by keyword searching,
5. No network maps evident on corporate website.

Figure 6.5: Evidence of the high regard of network maps for infrastructure marketing by Cogent Communications. Left image is the homepage of the corporate website, right image is the network map page. (Source: <www.cogentco.com>, August 2007.)

The most prominent and visible category - featuring network maps on the homepage - provides a strong indicator that these corporations see maps as a highly effective tool to promote their infrastructure to potential customers and investors. Remembering there can only be one homepage for the corporate website, screen 'real-estate' on this page is, consequently, at a premium and only the most significant items can command space. The survey results showed that of the thirty-eight corporations with some kind of marketing map, twenty-nine percent gave them high prominence by featuring them on the homepage. One of the best examples of this is on the homepage of Cogent Communications, that is ranked as the fourth most important corporation in terms of degree of Internet connectivity, which gives over a significant portion of available display space to a thumbnail maps of the USA and Europe (Figure 6.5), accompanied by a somewhat clichéd sales pitch: 'How our network translates into big savings for you'. This invites people to see more about the company's infrastructure and clicking on the map panel provides a direct hyperlink to a dedicated 'Network Map' web page displaying a large network infrastructure map and descriptive text highlighting technical capabilities (Figure 6.5, right-hand image).

The eleven corporations with the most prominent use of network marketing maps on their homepages tended to be the more important ones. Seven of them were located in the top twenty-five corporations surveyed according to their degree of Internet connectivity. While the bottom quartile had only one corporation, GTS Energis, featuring network maps directly on its homepage (Figure 6.6). As in the case of Cogent, clicking on the map on the GTS Energis homepage takes users to a dedicated network map web page.

Figure 6.6: The homepage of GTS Energis features maps prominently for marketing its infrastructure. (Source: <www.gtsce.com>, August 2007.)

The second category of prominence - maps readily displayed on subsidiary product or 'about us' web pages - accounted for over forty percent of corporations with some kind of infrastructure marketing maps (sixteen out of thirty-eight websites surveyed). In these cases, network maps are deemed to be effective for infrastructure marketing, but are perhaps not sufficiently important in the overall corporate strategy to command valuable screen space on the homepage.

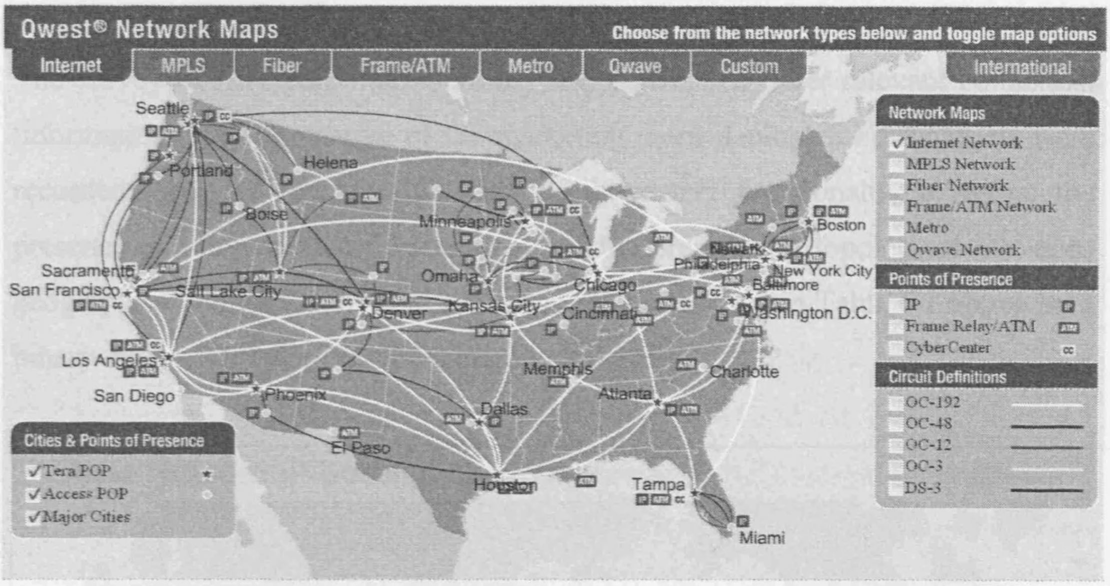

Figure 6.7: Example of the high quality network marketing maps available on the Qwest website. (Source: Author screenshot from interactive Flash-delivered map from <www.qwest.com>, August 2007.)

The third category encompassed corporate websites where infrastructure maps were present, but were not prominently displayed (i.e. the manual search required several minutes of browsing around and potentially clicking down through multiple layers in the website's information hierarchy). Eighteen percent of corporations were found in this class (seven from thirty-eight), which included well known U.S.-based companies, such as AT&T and Qwest. Both these corporation produce high quality network maps and make them available (e.g., Qwest's map shown in Figure 6.7; AT&T maps are analysed in section 6.4 below), but their lack of visibility in the website indicates they are not at the centre of marketing strategy at the time of the survey.

The bottom category are the corporate websites that literally hide their maps away and these could only be located by specific key word searching (for the phrase 'network map'). This applied to only four out of thirty-eight websites with some kind of marketing maps present. While a small minority, it rather surprisingly did include Sprint the third most important corporation in the survey according to its ranking on degree of Internet connectivity. So in a minority of cases mapping is not regarded as a particularly effective tools for marketing network infrastructure.

6.3.1.2 Website survey results: map scale and functionality

The survey of fifty corporate websites also considered other relevant contextual information about the nature of the marketing maps deployed. Four aspects were recorded: scale of maps; availability of interactive functionality to users; the presence of currency flag for the map; and the presence of topological (i.e. non-geographic) diagrams. These results are also summarised in Table 6.1 above by a binary display (filled = presence/ blank = absence).

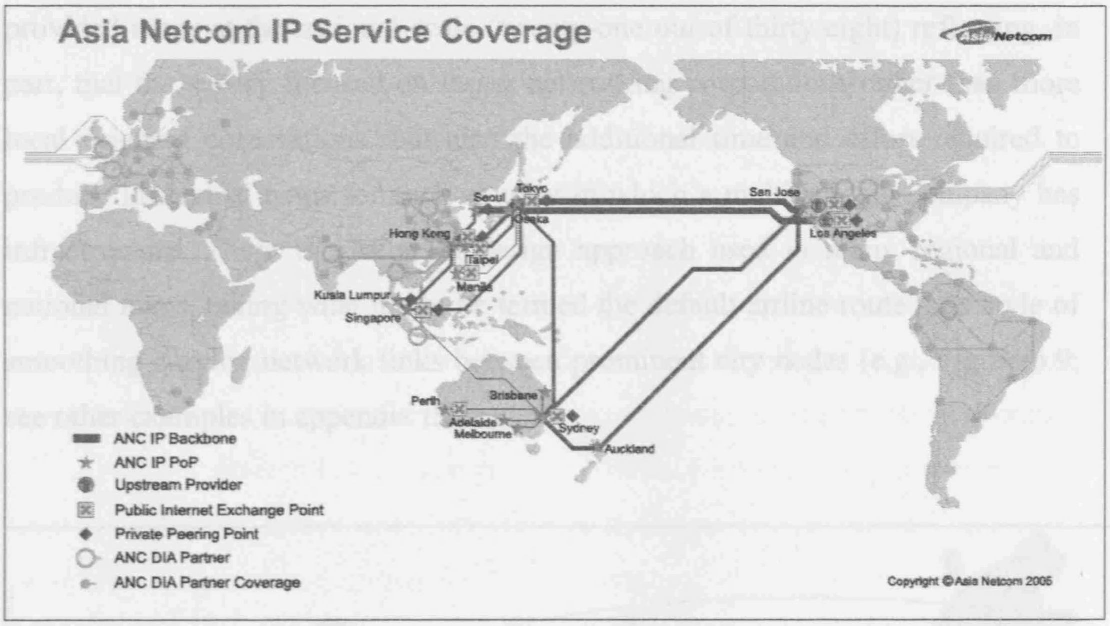

Figure 6.8: Small scale map presented on the Asia Netcom corporate website to promote its infrastructure. (Source: <www.asianetcom.com>, August 2007.)

The scale of maps deployed was recorded in four classes: small scale world maps, regional scale, national scale and large scale metropolitan maps. Twenty-four from the thirty-eight corporations presented world scale network maps of their infrastructure. (It should be noted that this partly reflects that these are typically large corporations with international operations.) A typical example from the corporate website of Asia Netcom (Figure 6.8) shows a highly generalised network representation of routes and hubs drawn on a generic world map. (Other examples can be consulted in appendix three and in section 6.4 below.) The map is centred on the Pacific to focus attention on the company's core operating territory, encompassed by the prominent blue lines of their backbone network. The design is conspicuously diagrammatic with angular routes reminiscent of the

Tube map, and without easily identifiable countries, the visual focus is given to the few named cities in which Asia Netcom has infrastructure. There are no details on the capacity of the network links. The currency of the data displayed is not specifically indicated but the image is copyright 2005, so already dated at the time of the website survey.

A greater percentage of corporations with some kind of network marketing maps deployed regional scale maps (twenty-nine out of thirty-eight websites). Fewer provided maps at the national scale (twenty-one out of thirty-eight) reflecting, in part, that the survey focused on larger networking corporations rather than more local oriented corporations, but also the additional time and effort required to produce individual maps for each country in which a multinational company has infrastructure. There is similar in design approach used in many regional and national maps, taking what might be termed the default airline route map style of smoothing curving network links between prominent city nodes (e.g., Figure 6.9; see other examples in appendix three).

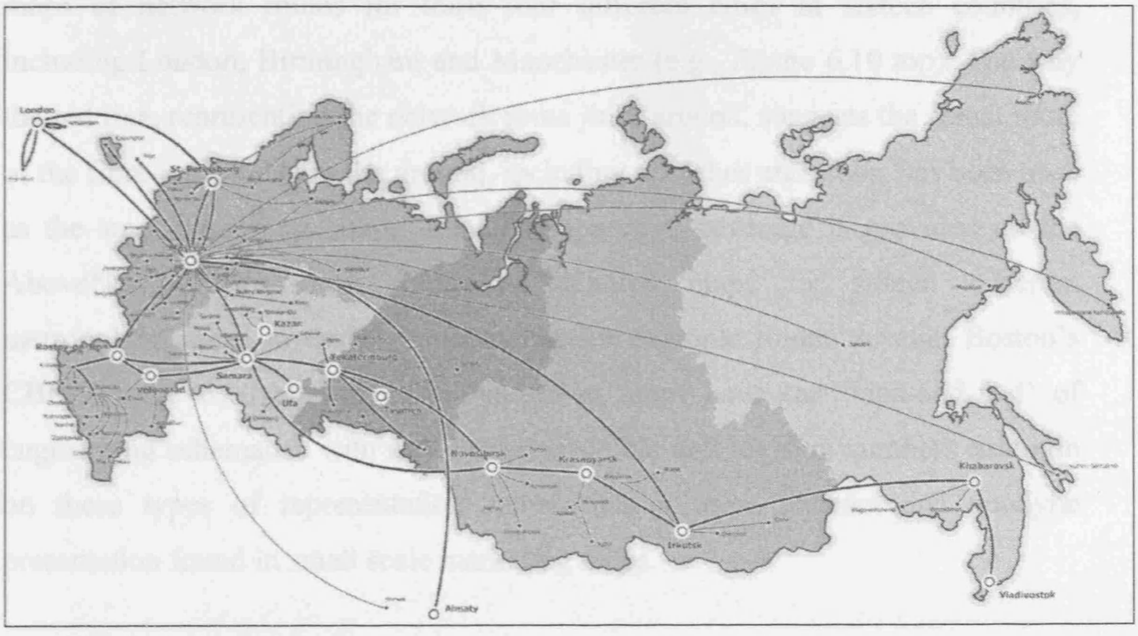

Figure 6.9: The network marketing map deployed by the RTCOMM corporation showing its infrastructure spanning the Russian Federation. (Source: <www.rtcomm.ru>, August 2007.)

The map is produced by RTCOMM providing Internet network services in the Russian Federation, and is prominently featured on its website. The map is dominated visually by the curving network link shown in red. What appear to be secondary hubs and links are shown in grey and fade into the background. The size and elongated shape of the country creates a challenge for representing the whole network infrastructure legibly on a single map; the international link to London is rather fudged and the weight of information is very unbalanced around Russian heartland leaving Siberian expanse as virtual blank.

The most detailed mapping showing infrastructure on a large scale in relation to metropolitan geography is relatively uncommon from the survey. Barely ten percent of websites with maps displayed metropolitan level mapping and these were almost all highly ranked corporations. This scale of mapping is not widely deployed for several reason, including the cost of production, security/confidentiality concerns, and because they are seen as having limited effectiveness for marketing. Yet the mapping provided by two companies, Colt and AboveNet, belies this trend by providing a surprisingly wide range of very legible and detailed street-level infrastructure mapping. Colt sells its networking services across western Europe and provides, on its corporate website, street-level maps of network routes for thirty-four different cities in sixteen countries, including London, Birmingham and Manchester (e.g., Figure 6.10 top). The way the red line, representing the network route jinks around, suggests the actual route of the fibre-optic cable in the ground, including branches and stubs, has been used as the source for these maps. Equally impressive coverage is provided on the AboveNet website, with thirty-five detailed maps for fifteen different metropolitan areas in the U.S., including for example routes through Boston's CBD (Figure 6.10 bottom). The AboveNet maps have the 'look-and-feel' of engineering schematics with neat-boxes, scale bar and revision numbers common on these types of representation rather than a more abstract and anodyne presentation found in small scale marketing maps.

Figure 6.10: Metropolitan scale network marketing maps from the corporate websites of COLT (top) and AboveNet (bottom). Infrastructure represented as cable routes along streets. (Source: <www.colt.net> and <www.above.net>, August 2007.)

The second contextual aspect of the network marketing maps audited by the survey was the use of interactive functionality. The focus was on whether the potential of the web as a media is being exploited by the corporations to extend the usability of their maps beyond inert representations (delivered as a raster image).

A fourfold classification of functionality was applied:

1. scaleable zoom and panning,
2. selection control over layers displayed,
3. interactive querying of features and/or keyword search,
4. dynamically generated maps features from 'live' data feeds.

In some senses this categorisation represents increasingly sophisticated functionality that requires more programming effort on the part of the cartographers / web designers. The final category of dynamic map generation, in particular, also requires significant behind-the-scenes software engineering to produce the actual graphics delivered to the users.

Figure 6.11: A screenshot of the interactive network mapping application provided by Internap. (Source: author screenshot of interactive application, <www.internap.com>, August 2007.)

Overall, forty-two percent of websites with some kind of network marketing maps utilised at least one of the four interactive features in displaying their maps. Unsurprisingly, the most widely deployed was the pan/zoom facility. Nearly all interactive maps were in packaged and delivered Flash applet, a popular web technology for authoring and delivery complex package of graphics. (Flash has been quite widely utilised for online cartography, cf. Taylor and Caquard 2006). One of the advantages of Flash over raster images is that it can deliver high-quality scaleable vector graphics, allowing pan and zoom by default. Given the greater costs to produce it is not unexpected that they are more prevalent in the larger, more important corporations in the survey; ten out of sixteen of the websites with some level of interactivity in their marketing maps were found in the top half of the ranked corporations. Although, interestingly the only corporation in the survey to provide a map offering all four interactive features, including dynamically generated data, was Internap Network Services, ranked at number forty-two out of fifty (Figure 6.11).

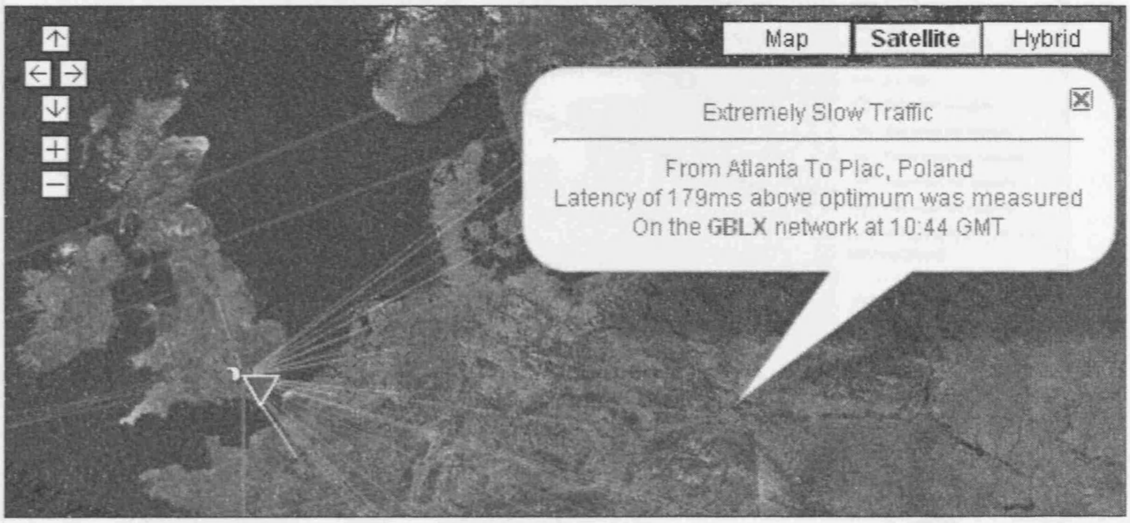

Figure 6.12: Detail of the Internap mapping system showing the result of an interactive user query on a data point on the map. (Source: author screenshot, <www.internap.com>, August 2007.)

The interactive mapping application is called ‘Eye on the Net’ and ingeniously seeks to promote Internap’s own infrastructure and services by highlighting poor network performance being experienced by other commercial network providers. The underlying cartographic ‘engine’ in the application is Google Maps, currently dominating online mapping with its seamless global map and imagery layers, and offering smooth zoom down to street level and high-resolution aerial photography backdrops in many metropolitan areas.

Internap's 'Eye on the Net' mapping application allows users to select which data layers are displayed and also toggle on/off different classes within each layer. Points of data traffic congestion (in terms of latency and volatility) are measured by Internap's 'observation points' (shown as blue triangles) and displayed dynamically as red and yellow dots. Indicator links from the observation points to the points of congestion can also be drawn, although its not indicated if the colouring of lines encodes any meaning. The user can also interactively query the congestion dots to obtain summary details on the time, location and nature of the performance problem, displayed in a small pop-up window (Figure 6.12).

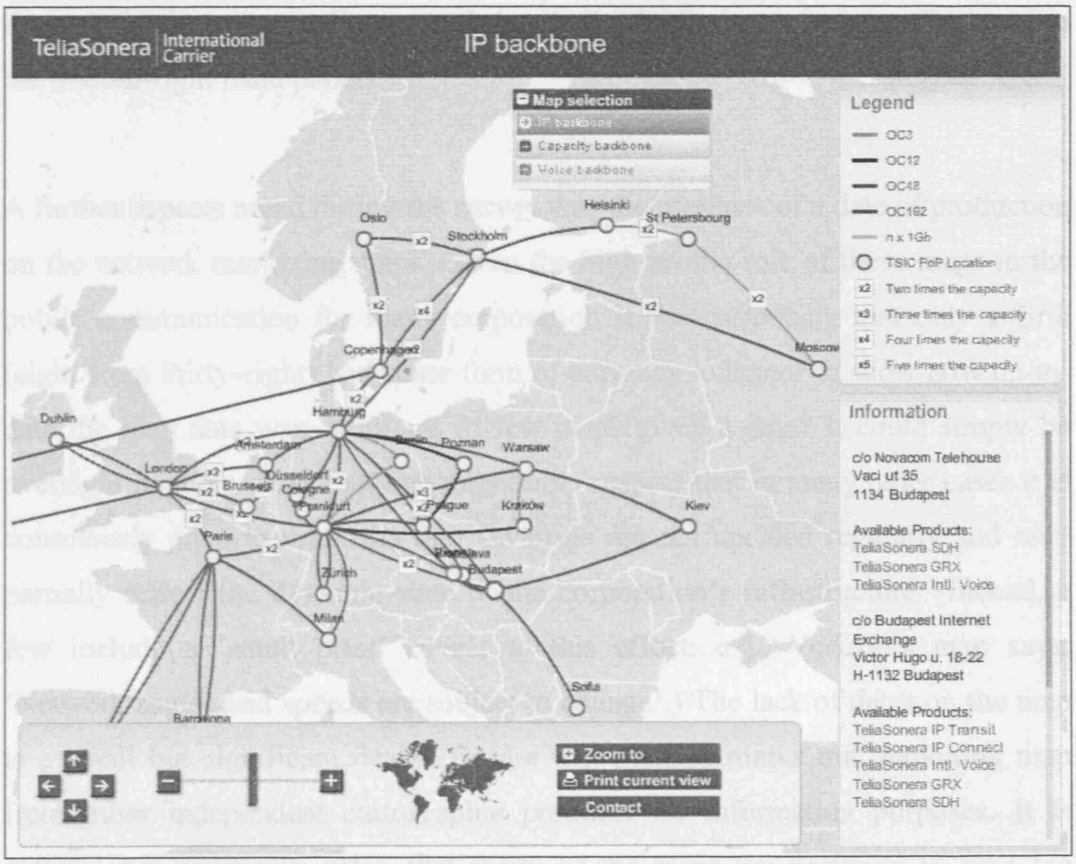

Figure 6.13: The interactive mapping application provide by TeliaSonera to market its network infrastructure. (Source: author screenshot, <www.teliasoneraic.com>, August 2007.)

Another noteworthy example of a well designed interactive marketing map is that provided by TeliaSonera (Figure 6.13). The company serves the Scandinavian and Baltic regions, and features the map prominently on its homepage. Although, it does not offer dynamic data generation of the Internap system, its link mapping is both aesthetically pleasing and more functional as it is classified by bandwidth. The symbolisation of bandwidth is achieved by colour coding link lines as well as using multiplier icons for routes with several links of a given capacity. The map is delivered in a simple-to-use Flash application that offers visitors the capacity to zoom and pan, to make layer selections and to interactively query nodes. The panel along the bottom of the display provides intuitive controls for the pan and zoom functionality. The 'map selection' menu allows users to choose one of three possible data layers (IP backbone, capacity backbone, voice backbone). The hubs in its network infrastructure (called 'TSIC PoP locations') can be interactively queried to give the street address and details on the particular services available through this location (in Figure 6.13 details for the Budapest hub are displayed in the bottom-right hand panel).

A further aspects noted during the survey was the presence of a date of production on the network marketing maps. Given the high profile role of these maps in the public communication for many corporation it was surprising that only a fifth (eight from thirty-eight) had some form of currency indicator to show how up-to-date the map data was. Why are so few maps given a date? It could simply be oversight in some cases, but one might also suspect that in many other cases it is consciously done to mask the fact the maps are not updated regularly and only partially reflect the dynamic state of the corporation's infrastructure. (Indeed, a few include a 'small print' caveat to this effect; e.g., Verizon's map says: 'Network routes and speeds are subject to change'.) The lack of dates on the map is a small but significant design feature that perhaps marks out marketing map from other independent cartographic products for information purposes. It is perhaps not surprising given that many of the maps are designed to give 'an impression' of the infrastructure rather than 'be precise' mirrors of reality, however this can be problematic when people choose to interpret them as representing being mirrors and not impressions (see also section 6.5.1 below).

This impressionistic aspect is made explicit by the legal sounding disclaimer made in small print on the Cable&Wireless maps: "This image is representative only and, to the extent permitted by law, Cable & Wireless plc makes no representation or warranty of any kind, whether express or implied, that the information contained in this image is accurate, complete or current. All liability for any loss or damage that may result from the use of this information as a consequence of any inaccuracies in, or any omissions from, the information, is expressly disclaimed." (see Figure 6.17 below).

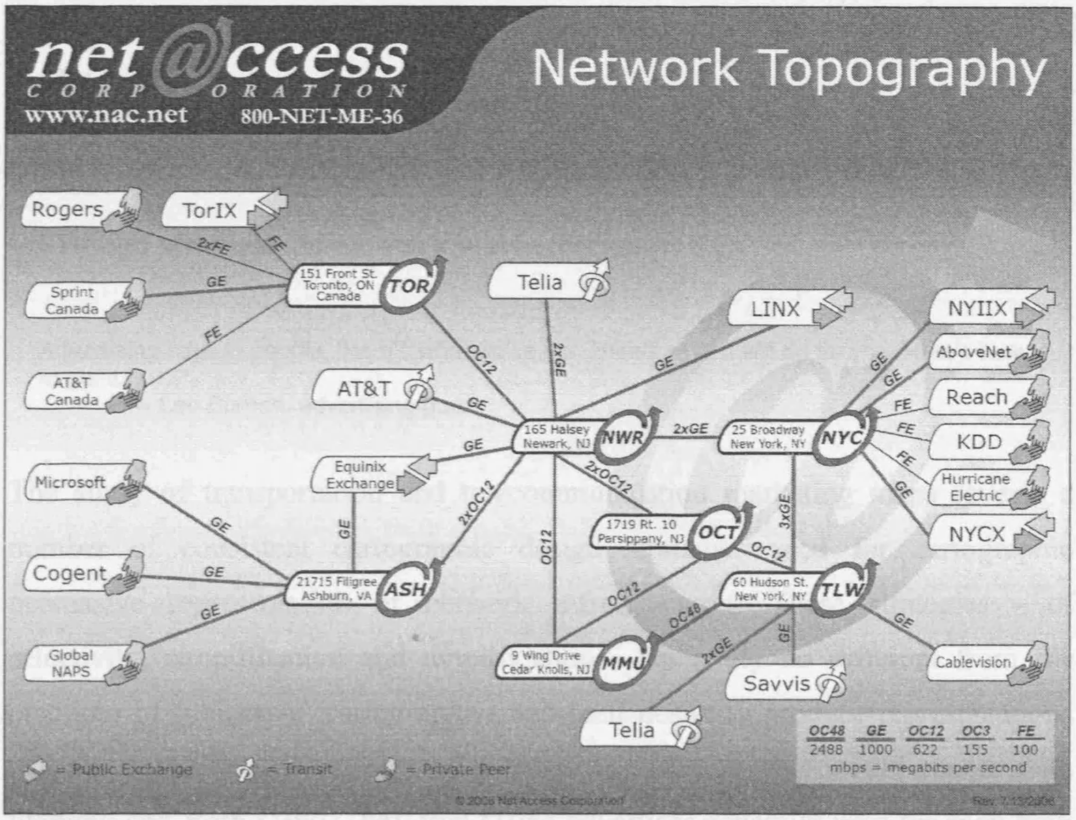

Figure 6.14: One of only two examples of topology diagrams employed to represent network infrastructure in the fifty websites surveyed. (Source: <www.nac.net>, August 2007.)

The final element noted in the website survey was the deployment of topology diagrams to market the corporation's network infrastructure. As discussed in chapter four, the use of topology visualization rather than cartography is a common trope for representing the structure of Internet infrastructure in different contexts. However, from the auditing the fifty websites it is clear that non-geographic representation are hardly ever used for network marketing. Topology diagrams were only found on two corporate websites; in one case, Net Access Corporation, only had a 'network topography' diagram and no geographic maps (Figure 6.14). The Net Access diagram has a quirky, rather unattractive, design common of topology diagrams. While it does give valuable detail (including bandwidth of links) it is apparent that this type of approach to representation is little used because it is ineffective for marketing. Topological diagrams and network graphs lack necessary visual rhetoric and do not matching peoples' expectations in wanting to see where the corporation's infrastructure is physically located in relation to a familiar geographical frame. These alternate kinds of diagram fail for marketing because they cannot 'ground' the intangible nature of the Internet.

6.4 Design strategies in network marketing maps

> Advertising says to people, 'Here's what we've got. Here's what it will do for you. Here's how to get it.'
>
> -- Leo Burnett, advertising guru.

The study of transportation and telecommunication marketing maps reveals a number of consistent cartographic design strategies used for cartographic persuasive representation of network infrastructures. These strategies - of selectivity, simplification and amplification - are really no different from the practices of 'objective' cartographies and their desire to produce representations that are as clear and unambiguous as possible. Importantly, I would concur with Fleming and Roth (1991: 290) that "[t]he advertiser generally uses the map both to enlighten and to persuade and only rarely to distort."; there is no evidence of outright cartographic lies in such infrastructure marketing maps - there is no need. The job of selling the network can be achieved more subtly through visual emphasis and suppression of map features.

Through a detailed interpretation of many network maps, including those audited in the website survey discussed above, a range possible representational choices - exploiting the full range of graphic variables for map features, along with textual elements (titles, labels, legends, etc.), projection and the overall layout – can be identified. These choices can be grouped into eight distinct design strategies:

range, reach, directness, centrality, abundance, capacity, silencing competition and exclusivity. (Usually, some combination of these strategies are employed; some strategies are easily combined, others are incompatible.) To establish how these strategies work it is useful analytically to distinguish between denotative signs (i.e. explicit information representation) in the map and the more connotative messages that are inferred from these by readers of the map. Cartographers may seek to connote positive messages to promote the corporation's infrastructure and services, but these may not necessarily be interpreted correctly, if at all (cf. Vujakovic 2002b). I briefly describe each strategy, noting the primary connotative meanings they seek generate:

- *Range*: 'our routes are the longest'

Fundamentally, the marketing goal of the map is to demonstrate, in compelling visual ways, the extensiveness of the network coverage offered by the company. Extensive range is best denoted cartographically by long route lines shown criss-crossing the whole map extent (or as much of the extent as is plausible without fraud). Line length is paramount as it draws the reader along the route, connoting a network with a powerful capacity to traverse distances and to transcend space. If the company is positioning itself as the premier national network, the map must try to show all of the country to be well covered with long route lines. Likewise, if the company is pursuing a globalist strategy, the map should demonstrate a fully world-wide range of routes, stretching across continents and effortlessly spanning oceans.

- *Reach*: 'our routes connect to all the right places'

Closely allied to impressions of extensive route coverage, is the need to demonstrate the reach of the network on the map. The reach of a network is assessed by how well it connects to *important* places. Importance, here, is determined by the target market for the network.

- *Directness*: 'our routes run straight and true'

The network should not only connect to all the important places, it should also denote as clearly as possible that it provides *uninterrupted*, point-to-point, links between these places). Networks with lots of interchanges connotes slower transmission - remembering that in Internet terms delays of a few hundred milliseconds can be significant to customers.

- *Centrality*: 'our routes are at the heart of the action'

The combination of a wide ranging network, directly reaching all the right places, should also connote the impression of a network offering all the advantages of centrality to customers, a network naturally positioned at the heart of things.

- *Abundance*: 'we have many routes'

"[N]umerousness indicates success, and success indicates a superior product" (Monmonier 1996, 68). Effective promotional network cartography, should not only show how much of the terrain is spanned or which places are connected, it must also powerfully demonstrate the sheer *abundance* of routes offered by the company. In prosaic terms, the company which is best able to show many routes, projects in connotative terms an image of strength through abundance, a sense of security through numerousness.

- *Capacity*: 'our routes can cope with demand'

Well proportioned lines denote lots of capacity and connote a strong, healthy network easily capable of meeting all demands without the risk of clogging or congestion. Conversely, 'skinny'-looking links can connote insufficient capacity to carry bulky loads and imply a risk of an under-strength network. Solidity of lines, through their graphic weight on the map, can also be useful in connotative terms as it implies the network is well engineered, it is secure and, above all, it can be trusted.

- *Silence Competitors*: 'show only our routes'

The silencing of competitors is the key characteristic differentiating informational cartography (serving the interests of consumers by mapping all available options) and promotional cartography (serving the interests of one company). Unsurprisingly, commercial network operators resist comparative mapping, particularly when their infrastructure, in terms of range, reach, abundance and capacity, does not stand up well against competitors.

- *Exclusivity*: 'privilege our routes above all else'

The role of a marketing map is to focus squarely on demonstrating the impressiveness of the network and it should not be cluttered with any extraneous contextual details that could distract readers. A degree of selectivity is, of course, inherent in cartography; however, in persuasive mapping, selectivity goes further to exclusivity - producing privileged views of world to service the needs of network marketing and the interests of capital.

6.4.1 Decoding the design strategies in five network marketing maps

The eight fold schema of cartographic design tactics proposed in the previous section is now applied to the network infrastructure deployed by five large telecommunications corporations that serve international markets and espouse globalist rhetoric. Summary details on the size five corporations examined is given in Table 6.2.

Table 6.2: Details on the size of five sample corporations, 2005. (Source: OECD, 2007, table 1.1.)

	Corporation	Revenues (USD millions)	Employees	Access lines (millions)
1	AT&T	43,862	190,000	86.9
2	British Telecom (BT)	35,480	104,000	36.5
3	Cable&Wireless	5,873	8,150	4.6
4	France Telecom	50,048	203,000	145.2
5	Verizon	75,112	250,000	105.0

These corporations publish high quality maps, at various scales, for marketing purposes. Four are delivered on their websites as interactive maps (using Flash applets), whereas Cable&Wireless also provides then as high-quality JPEG images for download (analysed here due to access problems). An example of the world maps offered by each corporation, displaying the maximum available data on their Internet infrastructure, was obtained for analysis in December 2007; these are reproduced as Figures 6.15 – 6.19 below. (Appendix three also provides a number of examples at different scales for these five corporations.) Superficially there is much in common between all five in terms of cartographic design for representing network infrastructure. They are all based on conventional layouts for world maps with North orientation and Atlantic centred projections.

All five corporations publish marketing maps at a range of different scales and offering readers various data layers. None of the five maps in the sample has specific authorship information displayed they are all, except BT's, adorned prominently with corporate names and logos. AT&T and BT's maps gave explicit date of issue/revision; AT&T, Cable&Wireless and Verizon provide some form of disclaimer as to the validity of the information shown on the map (as noted above the Cable&Wireless disclaimer, written literally in small print, is particularly fulsome).

The maps also had varying levels of significance in the marketing strategies of the five corporations analysed. According to the fivefold schema of map prominence in the website hierarchy set out in section 6.3.1 above, three corporations, BT, Cable&Wireless and Verizon, deployed their marketing maps at the second level ('network maps featured prominently on product pages'), AT&T had their marketing maps at level three (not especially prominent use of maps but can be found by browsing around), while France Telecom 'hide' their maps away from readers to some degree and they were only located by keyword search. Given that none of the five featured marketing maps on their homepages one could conclude that they were not essential to promotional agenda of the corporations.

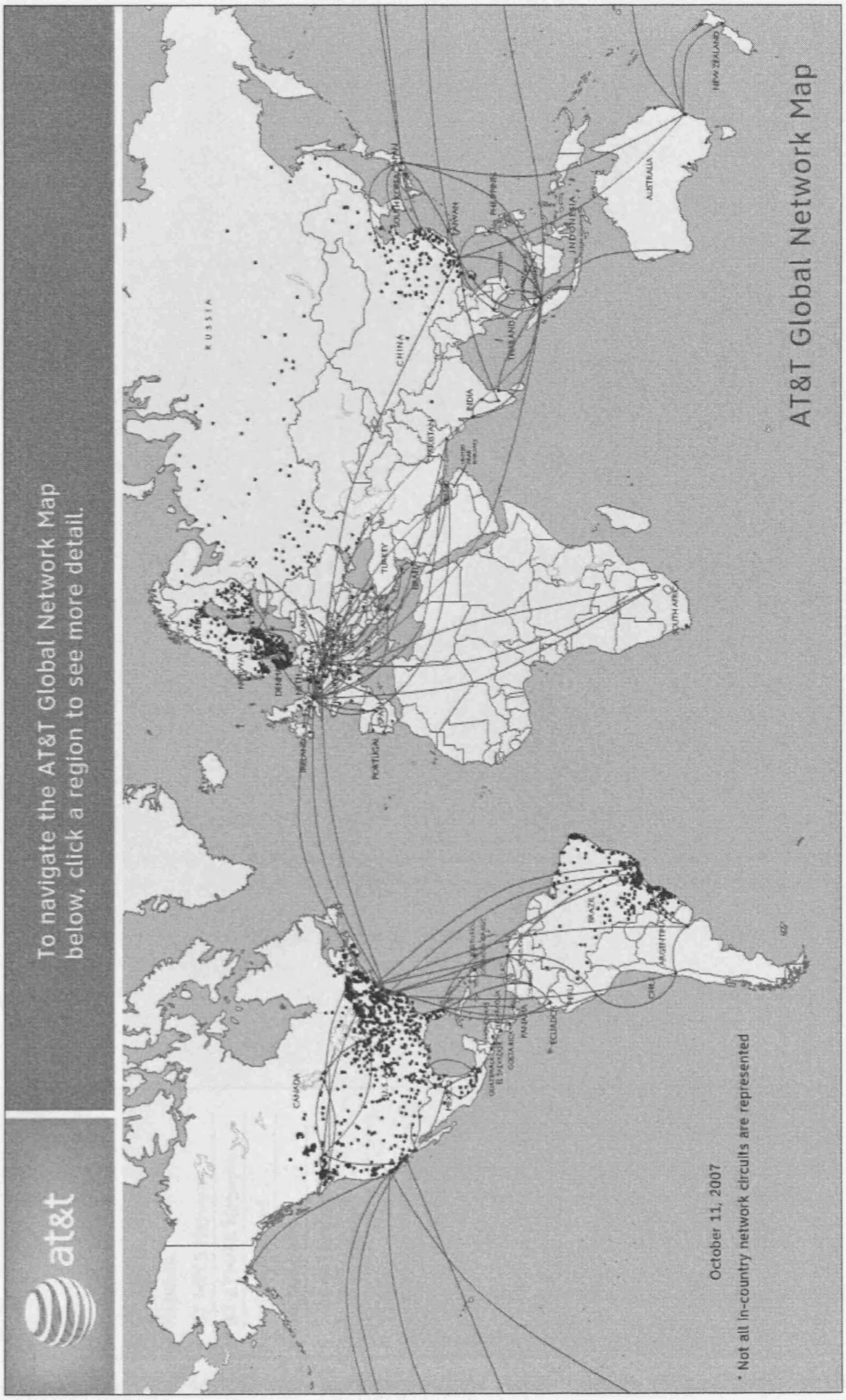

Figure 6.15: Global scale network marketing map for AT&T. (Source: author screenshot, <www.corp.att.com/globalnetworking/media/network_map.swf>, December 2007.)

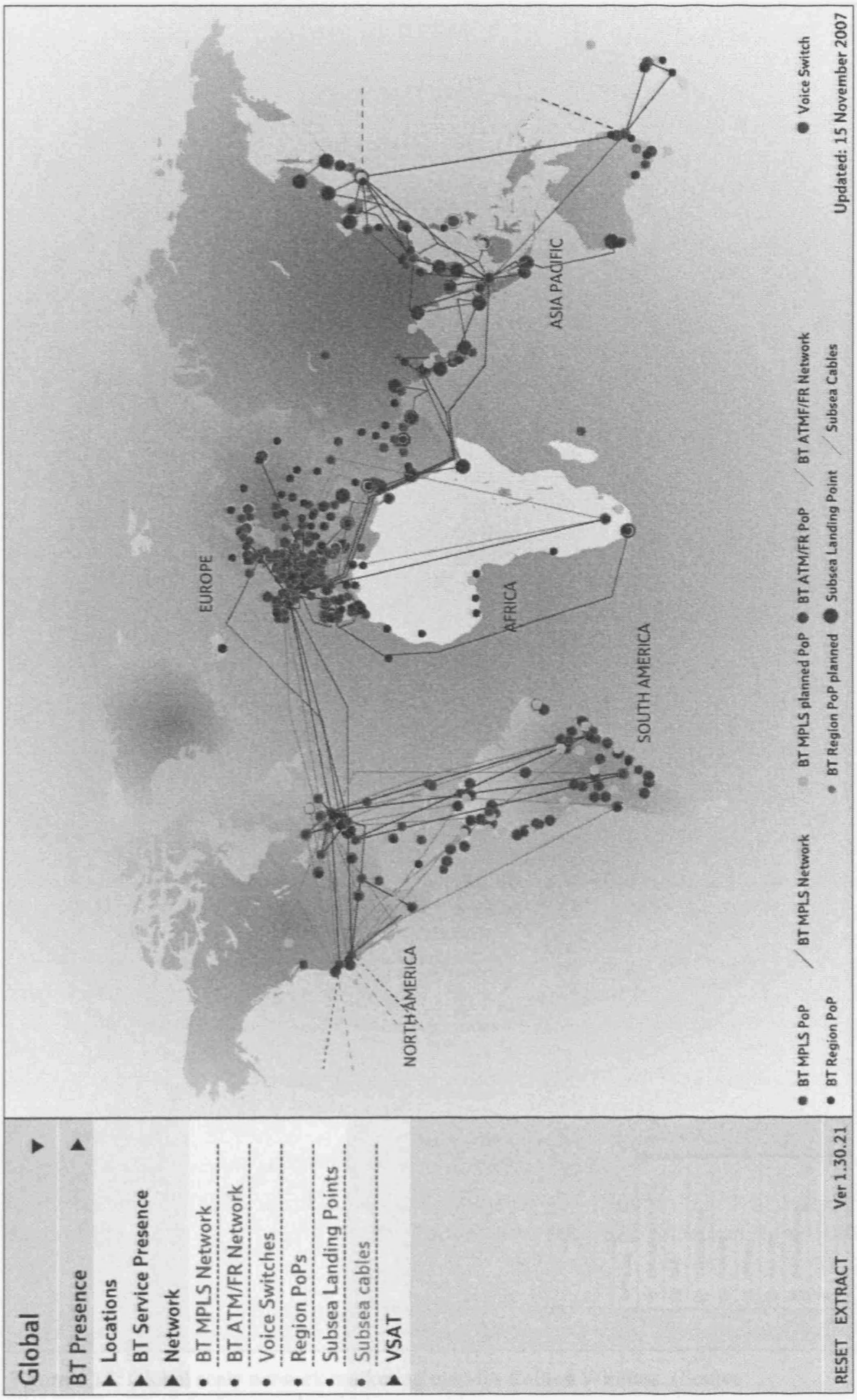

Figure 6.16: Global scale network marketing map for British Telecom. (Source: author screenshot, <www.btglobalservices.com/business/global/en/about_us/global_connectivity>, December 2007.)

Figure 6.17: Global scale network marketing map for Cable&Wireless. (Source: <http://portal.cw.com/wps/wcm/resources/file/eb34020c09dfbe0/All_Cables.zip>, December 2007.)

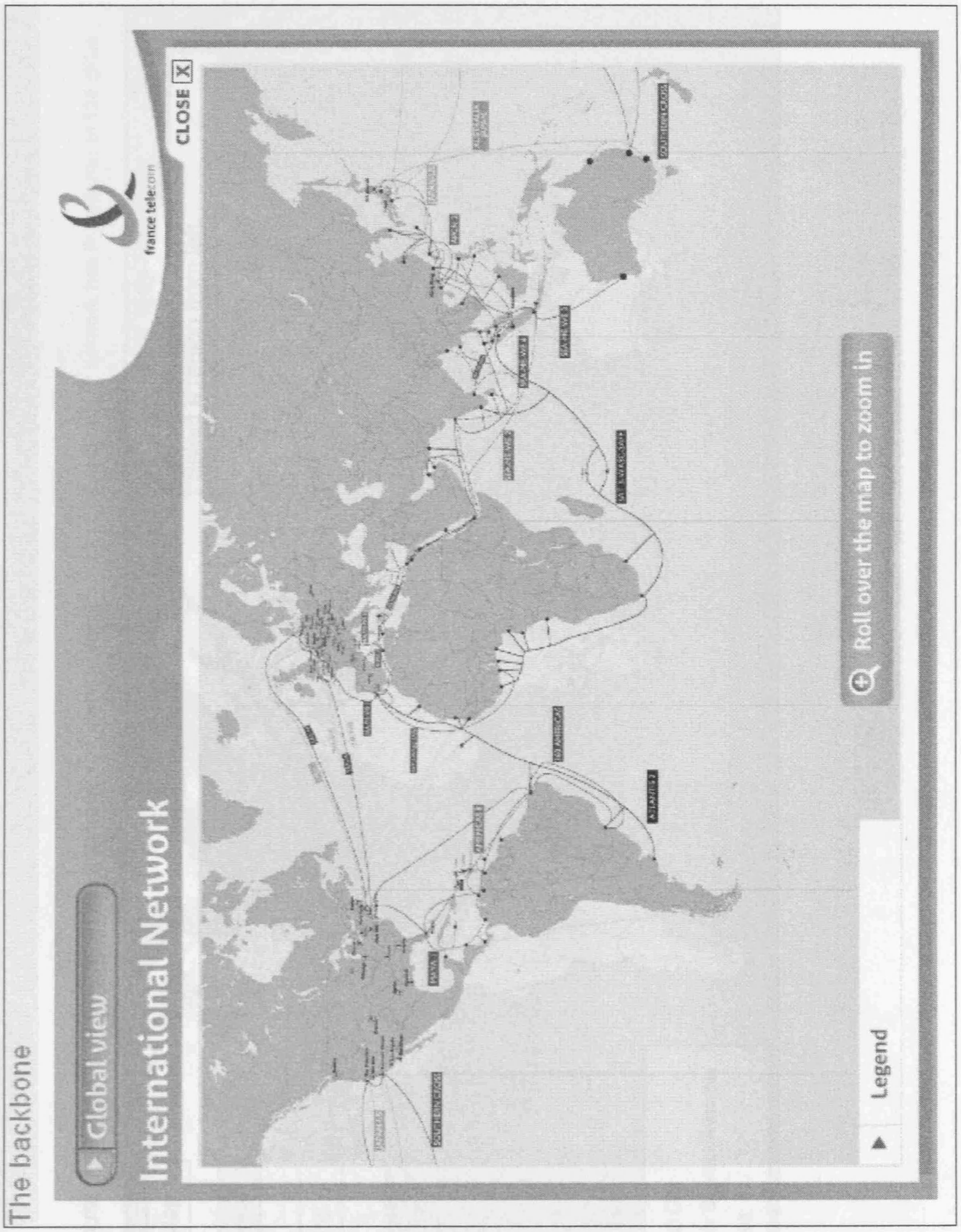

Figure 6.18: Global scale network marketing map for France Telecom. (Source: author screenshot, <www.francetelecom.com/en/our_solutions/wholesalesolutions/about_us/>, December 2007.)

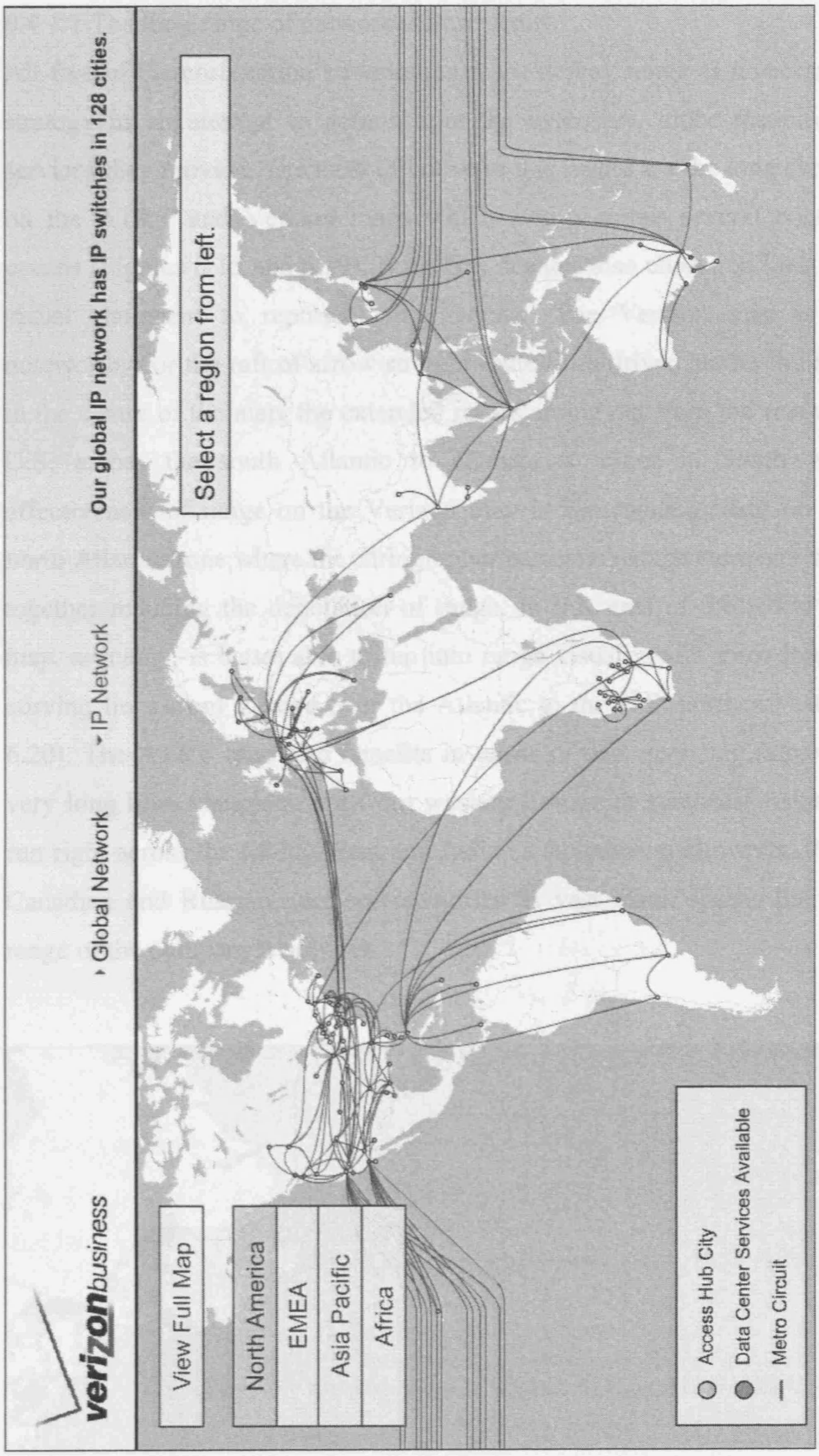

Figure 6.19: Global scale network marketing map for Verizon. (Source: author screenshot, <www.verizonbusiness.com/us/about/network>, December 2007.)

6.4.1.1 The long range of network infrastructure

All five of the corporation's marketing maps deploy range as a necessary design strategy in an attempt to demonstrate the extensive, globe-spanning, network services they provide. The most effective in this regard are the long curving routes on the AT&T and Verizon maps which sweep across several continents and oceans (Figures 6.15 and 6.19). Both map designs also chose red lines as a strong visual statement to represent their routes. The Verizon map is especially noteworthy for the raft of arrow straight route lines driven across the Pacific and, in the centre of the map, the extended routes arcing out from the east coast of the U.S. across the south Atlantic to connect to cities in South Africa. The effectiveness of range on the Verizon map is somewhat weaker on the crucial north Atlantic zone where the cartographer has bunched the company's route lines together reducing the denotation of range. In this area of the world the AT&T map, arguably, is better able to tap into range visually with three long smoothly curving lines from Europe over the Atlantic to the U.S. northeast cities (Figure 6.20). The AT&T map also benefits in terms of demonstrating range by several very long lines stretching out from western Europe to southeast Asian cities that run right across the Middle East and Indian subcontinent. However, there are the Canadian and Russian northern territories as vast blank spaces literally out of range of the company's network.

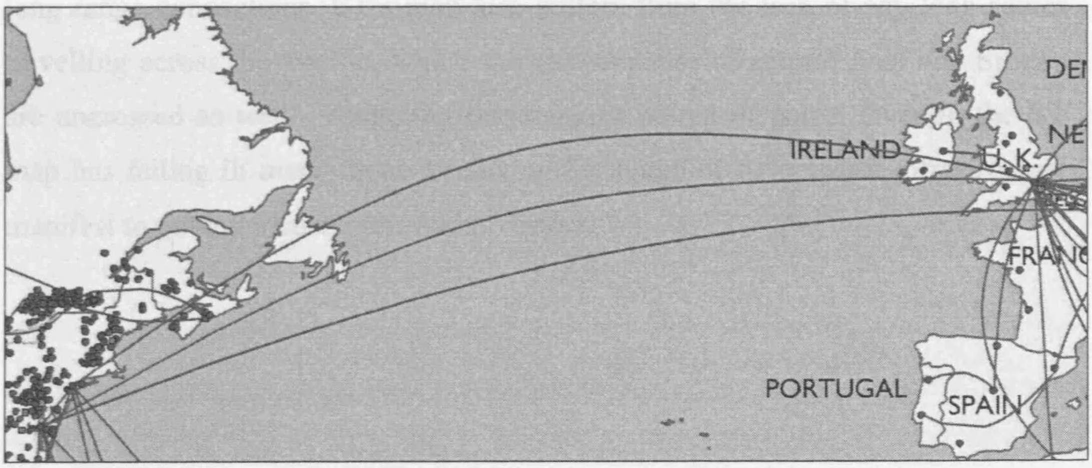

Figure 6.20: Effective demonstration of network range through long route line across the north Atlantic. A subset image taken from the AT&T map. (Source: author screenshot.)

Turning to the other three corporations, it is apparent that the maps deployed by BT, Cable&Wireless and France Telecom (Figures 6.16 – 6.18) are significantly weaker at demonstrating the powerful range of their infrastructure. The design of the Cable&Wireless and France Telecom maps consciously focuses on following the approximate geographical routes of submarine cables rather than tracing out notional point-to-point paths in the style of airline marketing maps. Submarine cables tend to hug the continental coastlines and consequently do no produce long route lines which are most effective for connoting range. France Telecom's map, in particular, is also lacking in visual impact in terms of range because it has no elongated routes crossing landmasses in many parts of the world, as such it appears that its infrastructure is not able to get beyond the shoreline. Cable&Wireless is marginally better in this regard with several long route lines on land, most notably those snaking across the vast expanse of the Russian Federation and northern China (also shown in inset Figure 6.24 below).

The somewhat different cartographic design of style of BT's map for representing network links results in shorter, straight and much more angular routes rather than continuous curves that appear to be longer. Such short lines are problematic for confirming the range of BT's infrastructure. Furthermore, like Cable&Wireless and France Telecom, BT utilises submarine cable routes that tend to follow the shoreline (e.g., through the Mediterranean) and thus cannot conjure up a sense of long range connections. BT's map also suffers from the lack of any long routes travelling across the Pacific, which the vast expanse of central Asia and Siberia are uncrossed as well - connoting these spaces as out of range. Overall, the BT map has failing in many areas in making the range of its network infrastructure manifest to potential customers and investors.

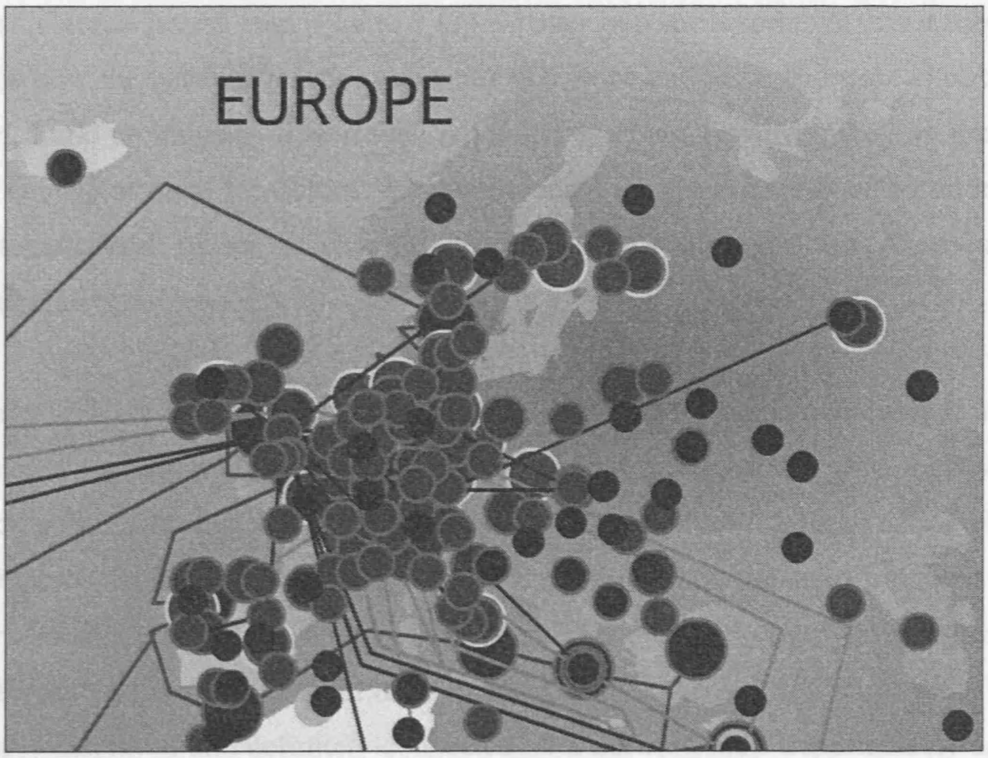

Figure 6.21: Europe is lost under a mass of nodes making it impossible to determine whether the network reaches the right places. A subset image taken from the BT map. (Source: author screenshot.)

6.4.1.2 The wide reach of network infrastructure

It is important in marketing terms that maps can prove the network has wide reach to connect to the most important places across the world. Arguably, none of the five maps examined perform particularly well at denoting reach. While both AT&T and BT (Figures 6.15 and 6.16) display a great many nodes across the world, none of the points are identifiable as specific and important cities, and the majority of these places are not visibly linked by the company's routes. Indeed, one could argue this lack of visual connections breaks the intuitive narrative of these marketing maps that the lines represent real cables carrying data to and from actual places. The message connoted from these maps is that a node without a link is disconnected, completely at odds with needs to convey network reach. In a few areas the sheer number of nodes are over-plotted and merge into an undifferentiated mass that again is unhelpful in expressing where specifically in world the network reaches, for example BT's mapping of its infrastructure in Europe (Figure 6.21).

The Cable&Wireless map (Figure 6.17) is better in some respects in that it tries to show how the network reaches key cities in Europe and Asia. Hubs are explicitly named and prominently drawn with red target symbols. However, there is simply not enough of them for Cable&Wireless to convincingly portrait itself as offering customers real global reach (the dearth of hubs across North America is particularly problematic).

France Telecom's map (Figure 6.18), with its focus on submarine cable routes, manages to display a good distribution of coastal nodes, drawn prominently as black points, but it is all too apparent that its network does not reach major cities within the interior of continents. In some respects then the map produced by Verizon of the sample in demonstrating reach, with a fairly even distribution of nodes across the world (except in Russia and China). All Verizon's hub cities are clearly displayed and definitely connected by a network link. Unfortunately none of them are named so as to unambiguously identify them as key cities, however zooming the map into a regional scale allows users to interactively query nodes to find out the city name and also its network connectivity (an example is shown in Figure 6.22)[12].

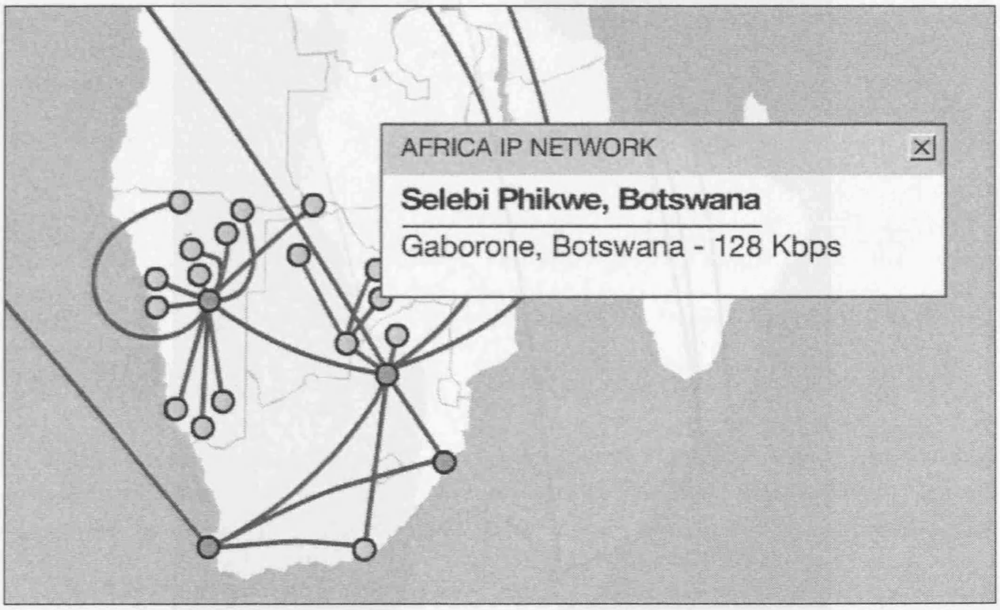

Figure 6.22: Querying a hub city on Verizon's network. A subset image of a zoomed version of the Verizon world map. (Source: author screenshot.)

[12] This example illustrates well the added value that interactive maps have over static images.

6.4.1.3 Direct network connections are indispensable

Besides reaching the right places, the most effective network marketing maps need to be able demonstrate how directly connections are made. Regarding the directness of network infrastructure, the Verizon map again scores best out of the sample analysed (Figure 6.19). There are a plethora of route lines projecting out from Verizon's core U.S. hubs to provide uninterrupted connections to multiple destinations in Europe, Asia and South America. Miami, for example, has seven direct routes to cities in Central and South America, along with connections across the Atlantic to Cape Town and Johannesburg (Figure 6.23). Such a quantity of direct city-to-city links denotes strongly that a network able to deliver data swiftly and reliably as there are no unnecessary detours or diversions. AT&T's map (Figure 6.15) is also fairly effective in this regard, displaying direct routes from its U.S. core to peripheral markets in Central and South America.

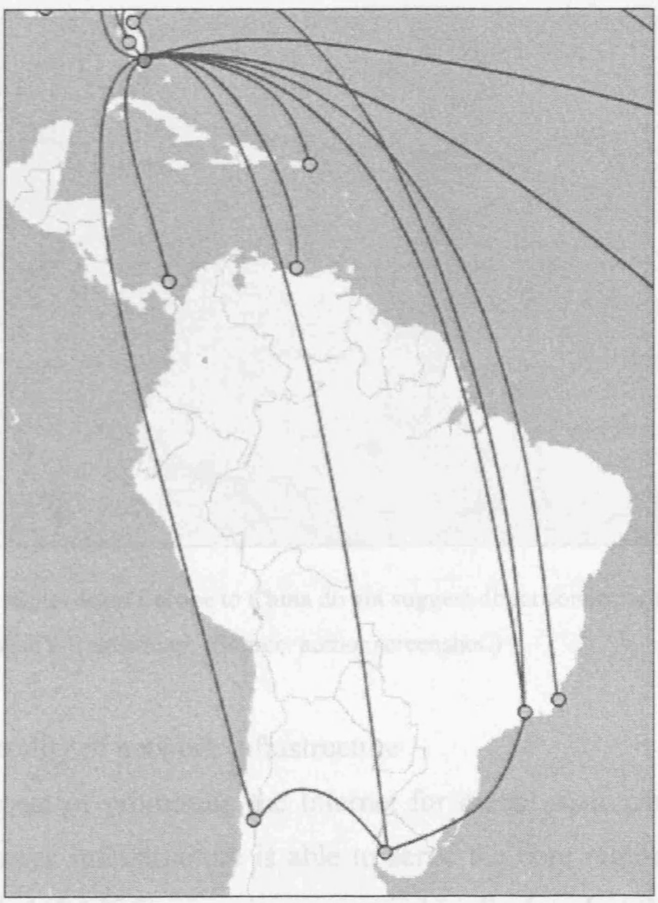

Figure 6.23: Example of direct connections from Verizon's Miami hub to multiple cities in Central and South America. A subset image taken from the Verizon world map. (Source: author screenshot.)

The representation of networked infrastructure mapped by BT, Cable&Wireless and France Telecom (Figures 6.16 – 6.18) appear much weaker at denoting direct routes to key cities. Indeed, France Telecom's map offers few unbroken connections, and the visual impression connoted from how the routes are represented is that the journey of data from the European core out to Asia promises to be circuitous and slow one, hopping between numerous cable landing points. One could argue the cartographer has produced a too realistic a representation full of wiggles and meanders taken by the actual cables. Cable&Wireless' route mapping also connotes of being sinuously languid, suggesting prolonged journey times as data must navigate all those curves – the overland route from the UK to China across the Russia Steppes is a particularly problematic case (Figure 6.24). The route line on the AT&T map, in comparison, just 'flies' from Europe to Hong Kong and looks considerably shorter and more direct.

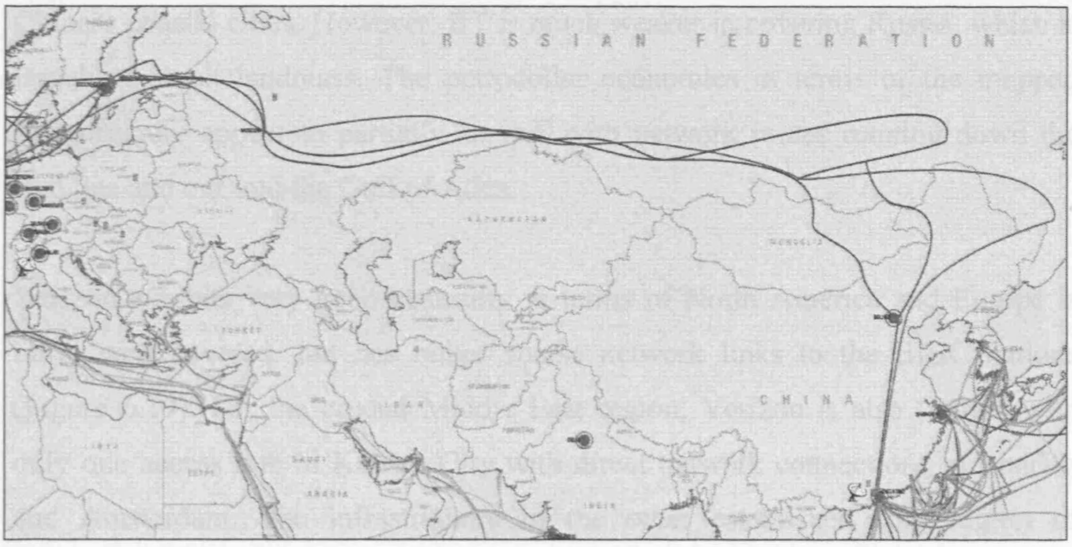

Figure 6.24: These routes from Europe to China do not suggest direct connectivity. A subset image taken from the Cable&Wireless map. (Source: author screenshot.)

6.4.1.4 The centrality of network infrastructure

Another key aspect of promoting the Internet for global scale corporations is to prove their network infrastructure is able to serve the core regions of the world economy. It is helpful if these regions are suitably displayed at the centre of the map as well. In a conventional reading, the core regions needing good infrastructure coverage would be North America, Western Europe and Southeast Asia, although this is expanding with the growing economic power of the so-called BRIC nations (Brazil, Russia, India and China) and also the powerful petrodollar economies in the Middle East. None of the maps in the sample cover all regions with equal effectiveness, reflecting the partial infrastructure provision of even the largest global telecommunications corporation and also the political economy of infrastructure ownership that still favours state monopoly providers (or privatised monopoly corporations) in many countries.

BT's map demonstrates good centrality, with it strong coverage of Europe with dense mass of hubs and a busy array of short angular network links (Figure 6.16). This impression is enhanced as this region is positioned in the middle of the map and at the focus of reader's visual attention. BT also exhibits reasonable coverage in North America and South Asia, visually important to any claim to centrality. In terms of the BRIC economies, BT appears from its marketing map to have a relatively good amount of infrastructure in Brazil and India and some nodes in Chinese coastal cities. However, BT is much weaker in covering Russia, which is largely a blank landmass. The petrodollar economies in terms of the mapped infrastructure appear to partially served, with network routes running down the Red Sea and out into the Gulf of Aden.

Verizon exhibits very good centrality in terms of North America and Europe is fairly well covered, but has rather sparse network links to the BRIC nations (Figure 6.19). For the crucial Middle East region, Verizon is also limited with only one access hub in Kuwait City with direct network connections to London and Amsterdam. The infrastructure in the other established core region of southeast Asia is also surprisingly restricted for Verizon, despite the large number of direct network links the corporation has heading into this region from the U.S. west coast.

In contrast, Cable&Wireless has a surfeit of cabling running throughout southeast Asia and Japan along with the appearance of adequate network coverage in northern Europe, but fails in asserting the centrality of its infrastructure because the key North American market appears under-served as there are no internal links or nodes (Figure 6.25). Surprisingly, the same serious failing applies to AT&T

which falls down in demonstrating centrality on its world map because it display no network links covering its U.S. heartland (Figure 6.15). This contrasts with Europe which AT&T covers well. The reason for the failure to display network links is a pragmatic design one, explained in part by the caveat under the date - 'Not all in-country network circuits are represented' – but in terms of connotations of centrality given to readers this is problematic.

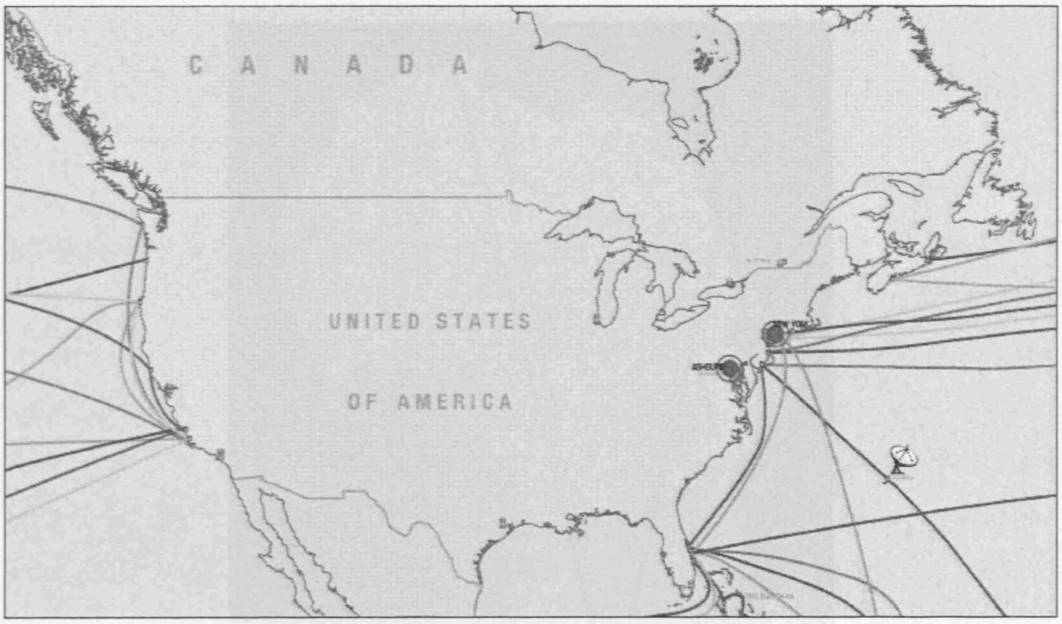

Figure 6.25: Blank North America region is a serious weakness in demonstrating centrality of network provision. A subset image taken from the Cable&Wireless map. (Source: author screenshot.)

6.4.1.5 An abundance of network infrastructure

In combination with centrality, the ability to demonstrate an abundance of infrastructure connotes trouble-free service availability as well denoting a sense of strength and reliability through redundancy. Again, BT does well with significant parts of its world map literally filled to overflowing with infrastructure nodes and links (Figure 6.16). Europe is completely covered, which for demonstrating abundance is very good, but as noted above, it is problematic for the specificity needed to illustrate the network reaches key places (Figure 6.21 above). However, the good work done with abundant European infrastructure coverage is immediately undone by the connectivity hole at the centre of BT's map – the stark emptiness of Africa (Figure 6.26). The almost complete lack of coverage stands out visually with the bright beige-coloured continental outline resting below Europe almost completely unconnected apart from a couple of routes that pass over the top of most of the population to link to South Africa and a submarine cable skirting conspicuously around the outside without making landfall. Greenland is also visually prominent in the middle of the map but devoid of any BT infrastructure whatsoever, as is the vast Russian landmass.

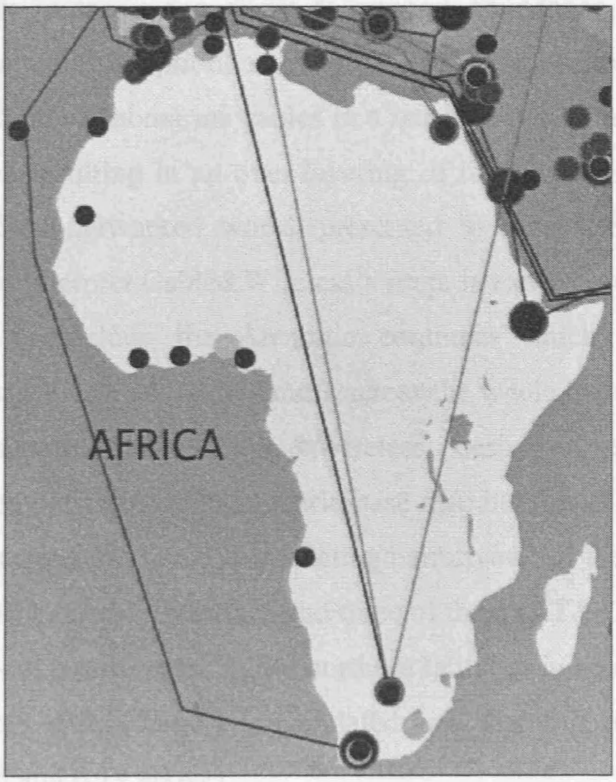

Figure 6.26: The emptiness of Africa in terms of infrastructure is antithesis of abundance. A subset image taken from the BT map. (Source: author screenshot.)

Both the U.S. based corporation AT&T and Verizon score relatively well on abundance, but only in restricted regions (Figure 6.15 and 6.19). Their maps utilise robust-looking red route lines crossing land masses and have many nodes shown prominently as black symbols that standout against the white country outlines. As with BT, however, both corporations suffer when considered in the whole because of the unconnected northern lands in Canada, Greenland and Russia seriously undermine the connotation of *global* infrastructure abundance.

France Telecom's marketing map is significantly weaker than these three because of its focus on undersea cable routes gives the appearance that it has no coverage across the continental landmasses of Africa, Asia, Australia or South American. Apart from some infrastructure sited in Western Europe and a skeletal network across the U.S., France Telecom's map fails to convince that the corporation has an abundant network able to meet demands of customers (Figure 6.18). Cable&Wireless is arguably the weakest of the sample as its map design has node symbols that lack visual bulk to make an impact and the line style used to represent network routes is too slight to suggest abundance in most regions (Figure 6.17). The only exception, and slight bright spot on the Cable&Wireless map, is the crowding of submarine cables in a narrow strip in the East and South China Seas region resulting in an over layering of lines to connotes abundance. The scale of the un-networked world, presented to prospective customers or investors trying to interpret Cable&Wireless's map, is exacerbated by the curious design decision to include the Antarctic continent which, because of the projection, looms as a vast empty landmass across the whole bottom portion of the image. It is apparent that Cable&Wireless designers chose the most geographically complete and detailed world base map but this is not necessary the most effective for denoting focused marketing narratives. All the other marketing maps in the sample exclude Antarctica and three of them (AT&T, France Telecom and Verizon) cut-off a portion of higher northern latitudes in an attempt to reduce extraneous territory that is largely unpopulated and, therefore, unconnected (see Figures 6.15, 6.18 and 6.19 above).

6.4.1.6 Confirming network capacity

Are routes suggestive of capacity to cope with growing global traffic in the marketing maps of these five telecommunications corporation? In most cases the answer is no, as the line styles employed lack the visual weight necessary to connote large carrying capacity. Furthermore, none of the five maps use the conventional design device of varying line symbology (either width, style or colour) to explicitly denote differential bandwidth capacity.

As in the case of the abundance strategy, the Cable&Wireless map is notably weaker than the others with its especially delicate looking network links between continents not connoting high capacity. While the lines are differentiated through colours this simply indicates the transmission protocol employed and not bandwidth capacity.

The marketing maps offered by BT and France Telecom are slightly better at connoting high capacity with somewhat stronger line styles and colours for the representation of submarine cables (Figures 6.16 and 6.18). While AT&T and Verizon's map make a markedly stronger visual claim to capacity with their routes drawn in a solid and readable red (Figures 6.15 and 6.19). However, neither take the opportunity to maximise the impact of capacity for marketing their infrastructure by proportionally increasing the line weight to show greater bandwidth on important routes. So on the Verizon map, for example, the high capacity transatlantic routes are denoted in the same way as the links in southern Africa which are an order of magnitude smaller in bandwidth. (Note, users of the Verizon map can determine bandwidth on different routes when zoomed into a region by an interactive query on city nodes; see example in Figure 6.22 above for Selebi Phikwe, in Botswana which has a connection of 128kbps, less than a typical domestic broadband connection in the UK.)

6.4.1.7 The silencing of alternatives

AT&T, Cable&Wireless and Verizon enact the silence prerogative completely in the design of their marketing maps by not admitting, in the slightest degree, the existence of Internet infrastructure that is not their own (Figures 6.15, 6.17 and 6.19). BT's map appears initially be silent of competitors and alternative networks, but on closer inspection the descriptions of infrastructure types in the legend tacitly admits that submarine landing points and certain undersea cables are not exclusively owned or operated by the corporation (Figure 6.16). Finally, France Telecom's map more seriously undermines the logic of the silencing through the highly visual labelling of every submarine cable system as different (Figure 6.27). This conscious naming invites speculation that France Telecom does not own or control these vital infrastructures and connotes that its network service merely piggy-backs across other systems. This is overly honest, one could argue, on the part of France Telecom as other corporations certainly buy transmission capacity on many of the same cable systems, but do not admit in their marketing maps to this dissolution of primary control over infrastructure. Such an admission in the map weakens the position of France Telecom to offer customers the total solution to their needs and to guarantee security of data delivery.

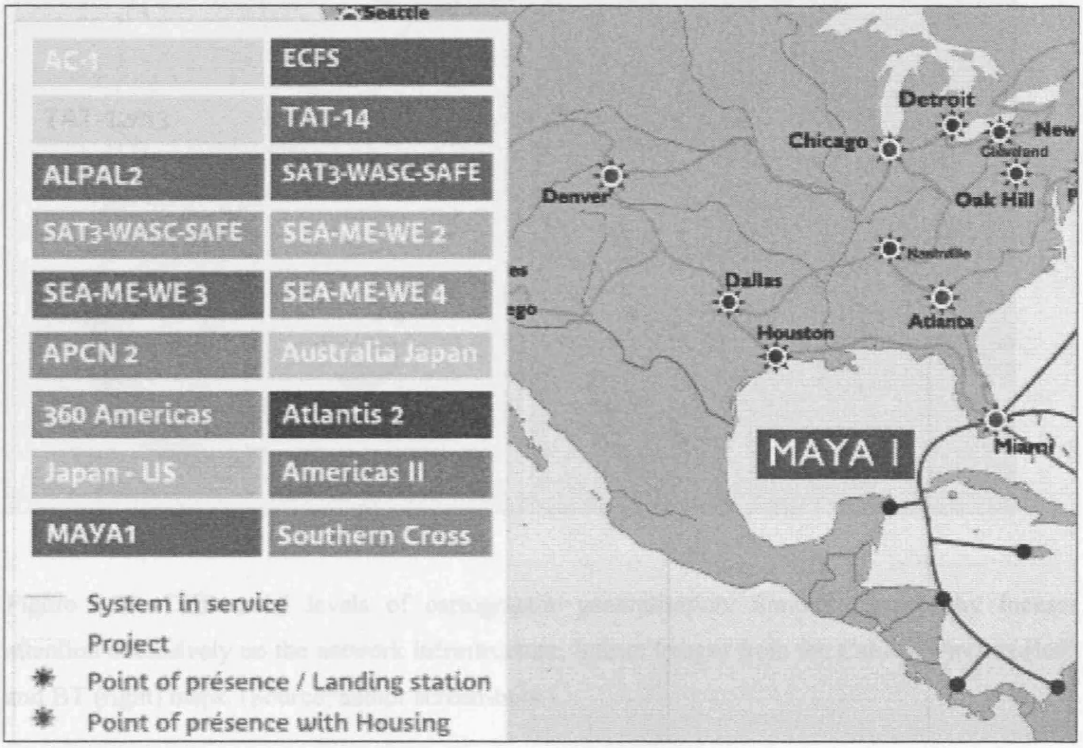

Figure 6.27: Silence is broken in the labelling of submarine cable systems. A subset image taken from the France Telecom map. (Source: author screenshot.)

6.4.1.8 The exclusive exhibition of the network

All the marketing maps have a strict focus on representing just the network infrastructure and avoid extraneous details in their overall designs. None of the five examples includes the technical paraphernalia common on many other world maps, such as a graticule or scale. They all use blank, and one might say 'default', Eurocentric outline maps showing just the shape and position of continents and nothing more. They are in some senses quite bland, lacking embellishment and having consciously excluded all topographic contexts (e.g., relief or vegetation), all thematic information (e.g., population distribution or economic activity), and all other modes of transportation. No natural features are named as these are irrelevant to marketing the Internet, a network existing apart from nature. This then is a primitive world of landmasses and unnamed oceans, a *terra nullius* onto which corporation can parade their wares.

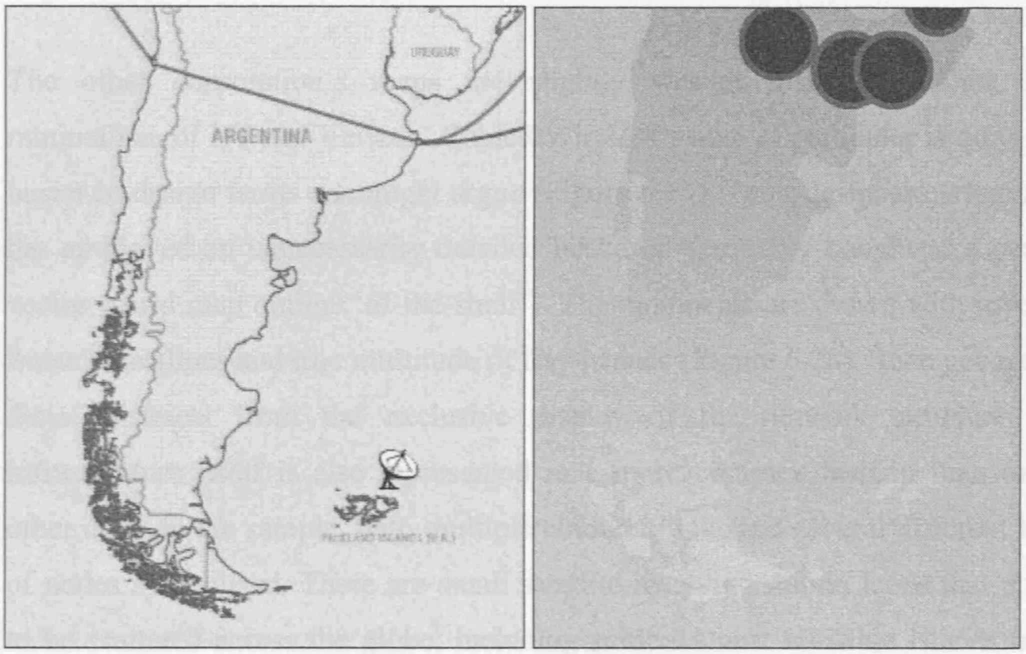

Figure 6.28: Differential levels of cartographic generalisation. Simpler cartography focuses attention exclusively on the network infrastructure. Subset images from the Cable&Wireless (left) and BT (right) maps. (Source: author screenshots.)

In evaluating the employment of exclusivity as a cartographic design tactic it is apparent that all the maps score well. BT and Verizon are the most effective of the five. BT's map, for example, even assuages country boundaries, plotting its network on top of stylised continental outlines, each of which is distinctively coloured (Figure 6.16). The shape of the continents themselves has also been significantly generalised which aids clarity of display and connotes them as mere containers for the corporations infrastructure (Figure 6.28). BT's map also has very little text on it, adorned with only five regional labels – nothing else it deemed important enough to name.

Verizon's map also exhibits a strongly exclusive focus and does not allow much else to distract readers from the core marketing narrative of demonstrating network geography (Figure 6.19). The continents are coloured virginal white, with only faint country boundaries. No countries, cities or other geographical features are named. The corporation's infrastructure itself is represented in a simple, yet visually strong, pallet of colours and symbols that envelopes an otherwise empty world.

The other corporation's maps are slightly weaker than the paired down minimalism of BT and Verizon. Cable&Wireless's map in particular is quite a bit busier in design terms one might argue (Figure 6.17). Their designer/cartographer has employed an unnecessarily detailed backdrop (probably bought as a generic vector world map outline 'of-the-shelf'). The continents are drawn with joyously fractal coastlines and true multitude of tiny islands (Figure 6.28). Such geographic detail distracts from the exclusive display of the network structure. The infrastructure itself is also represented in a more complex fashion than on the other maps in the sample, with multiple coloured links and several different kinds of nodes symbolised. There are small satellite receiving station icons that appear to be scattered across the globe, including some on near invisible islands in the middle of the ocean; arguably this appears as somewhat of a visual oddity and is a distraction perhaps from reading the network routes themselves.

6.4.1.9 Summary

While it is hard to give a quantified summary of the performance of the five maps analysed, it is apparent that their utilisation of the eight cartographic design strategies (range, reach, directness, centrality capacity, abundance, silence, exclusivity) was variable and, consequently, that they had varying degrees of success at connotatively generating positive impressions of the corporations' global network infrastructure coverage and capability to potential customers and investors. There is no clear winner as to the most potent marketing map in the sample, although it is noticeable that in a number of denotative areas the maps of AT&T and Verizon had superior performance over their competitors in the sample. Equally apparent was the relatively weaker performance of the France Telecom map at connoting positive messages needed for marketing. The somewhat curious design decisions made by the Cable&Wireless cartographer means its maps are also problematic at connoting a powerful and reliable network infrastructure that potential customers could trust.

6.5 WorldCom case study - backbone boom and the doubling myth

> There is no way to give us an understanding of any society, including our own, except through the stock of stories which constitute its initial dramatic resources. Mythology, in its original sense, is at the heart of things.
>
> -- MacIntyre, 1985, quoted in De Cock *et al.* (2001, 209).

Companies operating dedicated Internet backbones emerged in the late 1980s in the U.S., offering connectivity to businesses who were not able to use the academic networks, such as the NSFNET backbone. Many of these were small start-up companies, rather than established telecommunications carriers, and some grew out of regional consortia set up to connect local universities together (e.g., PSINET from NYSERNET in New York). One of the earliest commercial Internet network providers was UUNET, founded in 1987. Initially, UUNET was selling access to Usenet and grew to become a dominant U.S. Internet backbone operator by the mid 1990s, eventually being bought by WorldCom in 1996.

Table 6.3: Growth in potential bandwidth on U.S. domestic inter-city routes, 1999-2002. (Source: TeleGeography 2002, 9.)

Rank	Route	1999 (Gbps)	2002 (Gbps)	Multiple Increase
1	New York – Washington DC	7.5	137.4	18
2	Los Angeles - San Francisco	5.1	129.9	25
3	Sacramento - San Francisco	NA	124.9	NA
4	Atlanta - Washington DC	4.2	111.1	27
5	Chicago - New York	4.0	110.3	28
6	Dallas Fort Worth - Los Angeles	3.8	72.9	19
7	Philadelphia - Washington DC	0.7	68.9	94
8	San Francisco - Seattle	3.9	68.3	17
9	Dallas/Fort Worth - Houston	5.3	67.9	13
10	Portland - Seattle	0.7	64.9	88

(Gbps = gigabits per second)

The provision of fibre-optic network infrastructure in general, and Internet backbones in particular, experienced enormous growth in the 1990s, with the second half of the decade seeing an especially frenzied pace of new building in the United States and also in Europe. In what can now be seen as a classic example of bubble economics, billions of dollars were speculatively invested in laying thousands of miles of new cables, creating gigabytes of additional bandwidth. On many routes, available capacity doubled again and again in the space of a couple of years (Table 6.3), and several companies built wholly new national networks in the United States (e.g., Qwest, Level3 Communications) with the hope of capturing the lion's share of Internet traffic and positioning themselves as the dominant player in the so called 'New Economy'[13]. Technical advances in fibre-optic systems were important enablers of this infrastructure growth (see Hecht 1999), but the major driving force, at least to start with, was the undoubted 'bandwidth crunch' in the mid 1990s. Traffic on the Internet grew extraordinarily quickly in the period 1995-96, when many millions of new users came online in a very short space of time (Odlyzko 2000), and there were worries of a shortage of available capacity on key routes. Predicting ongoing traffic growth of this scale held out the inviting promise of rich financial rewards for those quick enough to meet burgeoning demand. Subsequently, the rapid growth in backbone building, paralleling the 'irrational exuberance' in the e-commerce sector, became a self-sustaining rush as companies sought to position themselves favourably, and investors hastened to avoid missing the opportunity. Unsurprisingly, there were many new entrants into the backbone market with ambitious plans, but little experience of running network infrastructure, who nonetheless attracted sizeable investments (Brody and Dunstan 2003).

Much of the new building was duplicative, covering the same routes and interconnecting much the same matrix of hub cities (Greenstein 2003). In a time of boom few seemed worried about problems of oversupply - this was time when 'New Economy' talk was rife and almost evangelical belief in never-ending exponential growth was prevalent. The key question about who exactly would use (and pay for) all this new capacity was never seriously asked. "[I]t was assumed that demand for the basic commodity, bandwidth, was unlimited, the recipe appeared to be 'can't miss!" (Brody and Dunstan 2003, 127). The hype-fuelled myopia from *within* the bubble, clouded judgement and the simple and convenient

[13] Besides new networks in the U.S., major investments were also made in intercontinental bandwidth with many ambitious new submarine cables systems. Billions more were spent on constellations of low-earth orbit satellites to provide data network services (such as Teledesic).

rationale of 'if we build it, they will come' was sufficient to lure many eager investors[14].

The problem was that the peak in Internet traffic growth in 1995-96 turned out to be a short-lived aberration. Customer demand thereafter, while still growing quickly at about 100% per year, was nowhere near rampant enough to absorb all the available new bandwidth being built (Odlyzko 2003). It is estimated that less than four percent of the fibre optic cable that was laid during the boom in the late 1990s was activated (Brody and Dunstan 2003, 146). The predictable outcome was a glut of bandwidth, resulting in falling prices and steep decline in revenues for network operating corporations. By 2001 many new entrants into the backbone market were in financial trouble, unable to service their large debts. The high-profile crashes of many dot-com companies in 2001 announced that the 'New Economy' was not so different from the 'old' economy after all, repeating much the same patterns as earlier cycles of speculative technological boom and bust (e.g., railways in the 1840s and broadcast radio in the 1920s). Yet, the sheer scale of the telecoms crash in 2002 was unprecedented, encompassing many of the best-backed companies (for example, the bankruptcy of Global Crossing cost shareholders $25.5 billion). The widespread bankruptcies of backbone providers also impacted on the large telecommunications equipment manufacturers such as Lucent, Nortel, and Marconi. In all, the bandwidth bust has been estimated to have cost investors around one trillion dollars (Brody and Dunstan 2003). The indignation of over eager investors at the poor judgement of company executives would be inflamed further by subsequent revelations of serious corporate deception and wholesale fraud in the backbone sector.

6.5.1 Deficient data on the Internet traffic growth

A serious problem for those planning and investing in Internet infrastructure in the 1990s was the lack of network knowledge on which considered calculations could be made. "It's not like transportation engineers putting down hard numbers for

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[14] The 'luring' was also aided by some dubious practices and bad advice given by an unscrupulous minority of the bankers, technology analysts and commentators involved (Brody and Dunstan 2003). With hindsight, the 'independence' of the advice given is in doubt as some of the advisers stood to benefit directly, through consulting fees and stock holdings, from the companies they were recommending to clients.

expanding the interstate highway system." (Behr 2000, H01). The dearth of useful and credible Internet traffic statistics, in particular, encouraged an over reliance on what turned out to be poor data.

The Internet is poorly understood statistically and economically, especially compared to other utility and transportation systems, because of the lack of representative published statistics on network size and traffic utilization. There are a number of reasons for this, including the newness of the system, the pace of its growth, its distributed scale of operation, and its heterogeneous ownership structures. Further, network owners have few, if any, incentives to publish representative traffic statistics - particularly as these may aid competitors. An alternative approach is instrumental measurement of the Internet by independent researchers but these attempts are usually flawed by unrepresentative distribution of sample points (cf. Murray and Claffy 2001). In terms of assessing backbone networks, as built, a number of statistics such as route miles, fibre miles, number of hubs have been published, for example in reports from TeleGeography (2002) and OECD (2002). Malecki's (2004) analysis of investment in fibre optic network in the U.S. for example relied, primarily, on unverified bandwidth aggregates between cities derived from *Boardwatch Directory* maps and provider marketing maps. Bandwidth is a useful but ultimately unsatisfactory variable (it is like developing road policy based on the width of tarmac between cities with no knowledge of the number of moving cars).

A characteristic of most of the available published statistics is that they show the Internet is expanding quickly and in the boom of the late 1990s the *best* of these statistics, and those that got the most attention, were the ones showing the greatest degree of expansion. Yet, too often these growth statistics were of dubious quality based on unscientific methods and unrepresentative samples. While some were well-meaning guestimates and others merely speculative, a few were fabricated - numbers literally plucked out of the air to feed to technology journalists and to be disseminated out to the financial markets receptive for the latest statistics supporting the boom mentality. Such statistical 'evidence' encouraged people to believe growth was happening everywhere and knew no bounds. It directly fed the dot-com hype and the hype, in turn, fed back to those generating evermore extravagant numbers (Jordan 2001).

The lack of representative data on data traffic growth opened the way for the biggest - and some claim the most fraudulent - piece of statistical evidence to circulate, that traffic Internet was doubling in size every 100 days or so. This corresponds to annual growth rates in excess of 1,000%. Importantly, the origin of this evidence is specific to traffic data at one time point and for one network, but it became accepted as universal truth. As with other technology myths, such as nuclear-war survivability of the early Internet (cf. Abbate 1999), once the statement circulates it gains credibility through retelling, particularly when the retelling is in high profile outlets, including in government reports, and by credible industry insiders (see Odlyzko 2003 for full discussion). For example, the doubling myth was stated as fact in a widely circulated 1998 U.S. Department of Commerce report[15], while the former chairman of the U.S. Federal Communications Commission, Reed Hundt, recited it in his book on telecommunications reform, *You Say You Want A Revolution* (2000). The power of such myths is, of course, that they tell people what they want to hear and in the late 1990s many people wanted to believe that the Internet was growing so fast that it was rewriting the laws of economics and would revolutionise society. And that the growth in traffic and infrastructure demands would continue to justify extravagant claims in business plans.

The origins of the 'traffic doubling every 100 days' myth have been traced, through forensic bibliographic analysis by Andrew Odlyzko (2003), back to comments made by UUNET chief scientist Mike O'Dell in 1996. It was subsequently repeated in a February 1997 WorldCom press release and further reiterated several times during the late 1990s by senior executives in WorldCom, including CEO Bernie Ebbers. Even as late as September 2000 it was the mantra of the company, with Kevin Boyne chief operating officer of WorldCom's

[15] *The Emerging Digital Economy* report (April, 1998) stated in its introduction: "Traffic on the Internet has been doubling every 100 days" (page 5). On page 11, the report also stated: "UUNET, one of the largest Internet backbone providers, estimates that Internet traffic doubles every 100 days" (see <www.technology.gov/digeconomy/EmergingDig.pdf>).

Internet division UUNET quoted in a Washington Post article saying unequivocally: "[o]ver the past five years, Internet usage has doubled every three months" (Behr 2000, H01). In promulgating the myth so widely it is clear that it was useful to WorldCom's business strategies and as such they must share responsibility for hype of the bandwidth boom (Economist 2002).

The roots of the myth of 'traffic doubling every 100 days' are situated in the unprecedented growth spurt for the Internet in 1995-96 when it might well have been true, at least for a time for UUNET's own network. However, detailed analysis by Odlyzko (2003) of a range of traffic data from different networks shows that over the period as a whole growth was only doubling annually. Yet, the 'doubling every 100 days' myth continued to be touted as truth for the rest of the decade and its simplicity and promise of potential revenues meant that it came to underlay the backbone boom (Dreazen 2002; Economist 2002). In this way, the myth was dangerously misleading and damaged the whole industry. "WorldCom's phantom growth caused once-mighty telecommunications companies like AT&T to cut prices and slash costs in the crippling race to keep up, from which they never fully recovered" (Belson 2005, no pagination).

6.5.2 WorldCom's rise to the 'World-Con' bust

WorldCom's relatively short corporate history began in 1985 with the arrival of Bernie Ebbers, then a small-time entrepreneur in Mississippi, as owner of a small telephone company called LDDS. Through numerous take-overs and aggressive business manoeuvres, Ebbers quickly grew LDDS into a multibillion dollar operation providing a full range of telecommunications services. In 1995 LDDS re-branded itself as WorldCom, a name befitting it globalist business ambitions. At its height, WorldCom was second only to AT&T in the U.S. long-distance telephone market and the dominant global player in the Internet backbone business. Importantly, this achievement was facilitated by neoliberal structural and regulatory changes that reconfigured the U.S. telecommunications landscape during this period. A key part of these changes was a lessening of government oversight of corporations' financial practices.

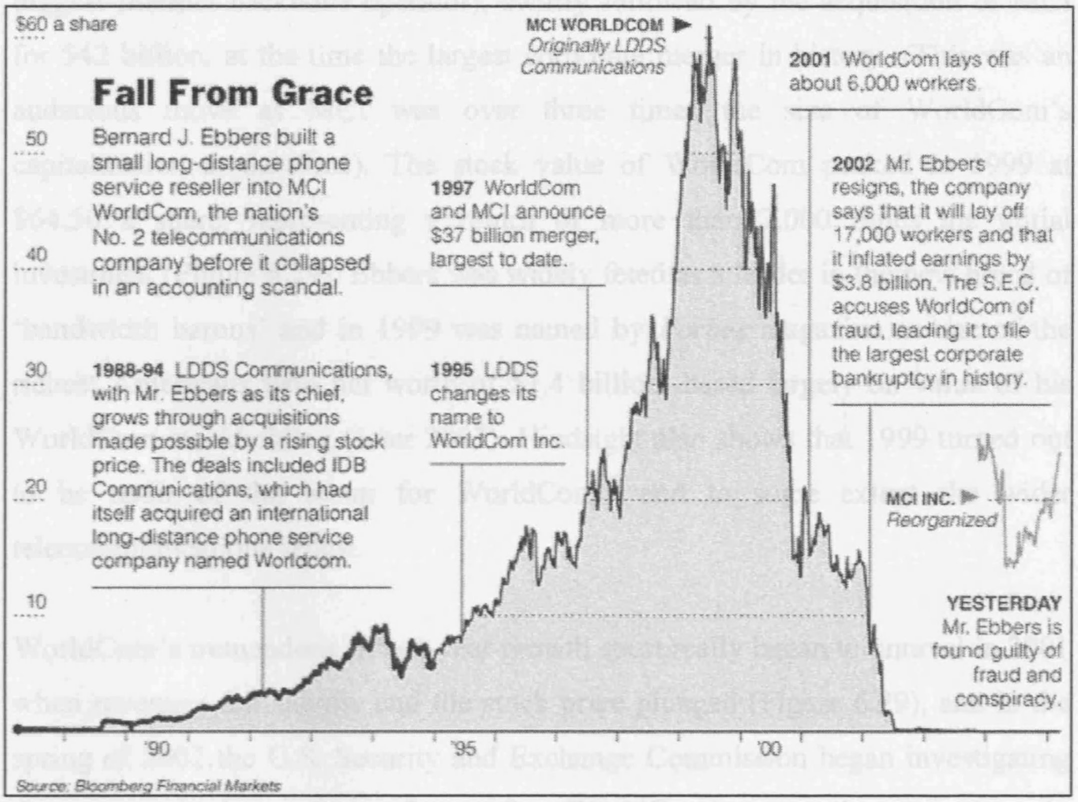

Figure 6.29: The fluctuating share price of WorldCom in relation to its corporate history. (Source: graphic accompanying Belson 2005.)

Table 6.4: Principal WorldCom acquisitions, 1995-2001. (Sources: Jeter 2003; Sidak 2003, 241; corporate press releases.)

Date	Target	Price (USD billions)	Core business focus
Mar. 1995	WilTel Networks	$2.5	Facilities-based CLEC
Aug. 1996	MFS, UUNET	$12.5	IP network provider
Jan. 1997	Brooks Fiber	$2.4	Facilities-based CLEC
Jan. 1998	CompuServe	$1.3	ISP
Jan. 1998	ANS Communications	$0.5	ISP
Aug. 1998	Embratel	$2.3	Brazilian long-distance provider
Sept. 1998	MCI	$40.0	Long-distance provider
[Oct. 1999	Sprint*	$129.0	Long-distance provider]
Oct. 1999	SkyTel	$1.7	Paging service
July 2001	Digex	$5.8	Hosting services

* This merger was effectively blocked by government regulators in the U.S. and EU.

WorldCom was a major contributor to the Internet backbone bubble in the second half of the 1990s, engineering corporate expansion on a monumental scale with a string of billion dollar acquisitions and mergers (Table 6.4). Key in these were the 1996 take-over of MFS Communications (which included UUNET, then the biggest Internet backbone operator), swiftly followed by the acquisition of MCI for $42 billion, at the time the largest corporate merger in history. (This was an audacious move as MCI was over three times the size of WorldCom's capitalization at the time). The stock value of WorldCom peaked in 1999 at $64.50 a share, representing a return of more than 7,000 times the initial investment (Figure 6.29). Ebbers was widely feted as a leader in the new breed of 'bandwidth barons' and in 1999 was named by *Forbes* magazine as one of the richest Americans with net worth of $1.4 billion, based largely on value of his WorldCom stockholding (Jeter 2003). Hindsight also shows that 1999 turned out to be nadir of the boom for WorldCom[16] and to some extent the wider telecommunications sector.

WorldCom's tremendous fifteen year growth spurt really began to unravel in 2001 when revenues fell sharply and the stock price plunged (Figure 6.29), and in the spring of 2002 the U.S. Security and Exchange Commission began investigating the corporation's accounts. Soon after WorldCom's reputation was brought crashing to earth with the public exposure of huge accounting irregularities of $3.8 billion[17], confirmed in a June 25 2002 company press release. The stock price plunged to 20 cents and many thousands of employees were laid off overnight. On July 21 2002 WorldCom was forced to file the largest bankruptcy in the world, amidst allegation of criminally fraudulent practices on the part of the senior executives. The media quickly re-branded the company as 'World-Con'.

WorldCom's fraud, along with the collapse of ENRON in December 2001 and the associated failure of the global accountancy firm, Arthur Anderson, represented a significant blow to confidence in the financial probity of U.S. business and prompted calls for new legislation on corporate governance. There were other repercussions: "[a]s people from all walks of life watched as WorldCom's betrayal devastated their investments and retirement nest eggs; they wanted to know what went wrong – when, why, and how?" (Jeter 2003, xxi). WorldCom's

[16] Note, at the end of 1999 WorldCom planned a massive merger with Sprint a deal that would have been worth a staggering $129 billion. The merger was blocked by threatened monopolies investigation from U.S. and EU regulators.

[17] The total fraud was eventually tallied to $11 billion (Belson 2005).

fall was also part of an industry-wide collapse in the market for network services in what has been called the 'great telecoms swindle' (Brody and Dunstan 2003). In the ensuing fallout, some commentators have focused blame on WorldCom for deliberately exaggerating the extent of Internet growth (e.g., Dreazen 2002; Economist 2002) and Sidak's (2003) detailed analysis of failures in regulatory oversight of the telecommunications market, uses the 'traffic doubling' myth as a key element in his legal arguments on the potential liabilities of WorldCom. He argues that WorldCom's market power brought a duty to report honestly: "In retrospect, it appears that WorldCom used this asymmetry of information to exaggerate the value of its stock by overstating the growth in Internet traffic volumes" (Sidak 2003, 230).

The proceeding story of backbone boom, deficient data and traffic growth myths is significant context in which to examine the representational politics of Internet infrastructure map. The marketing maps that WorldCom produced to promote their businesses played an important part in shaping the geographic imaginary of the Internet as a whole, and furthermore, some of this cartography was also complicit in highlighting the boom and denying deceit underlying it.

6.5.3 Decoding the design strategies in WorldCom's marketing maps

> The network maps are a critical sales tool for us - throughout the world.
>
> -- Henry Ritson, global marketing manager, UUNET - An MCI WorldCom Company, 2000.

The cartographic design strategies of the marketing maps used to sell network infrastructures will now be considered in detail in relation to one specific Internet backbone company, WorldCom. The focus of the analysis is on a sequence of different global scale marketing maps published online by the corporation 1997 to 2001. The comparison of maps over time reveals the evolution of the design strategies to best promote the corporation's growing network infrastructure. WorldCom's maps are also noteworthy because they cover a significant period in the Internet's development and represent an economically significant sample of the whole backbone industry in the late 1990s.

A sample of seven different maps are analysed here using the framework outlined in section 6.4.1 above (Figures 6.31 - 6.36 below). In addition to the cartographic materials gathered periodically from WorldCom's public corporate websites, an email interview was conducted in April 2000 with Henry Ritson, then global marketing manager at UUNET, who had responsibility for the production of the maps for much of this period (more detail published in Dodge 2000c).

Our Network

MCI's extensive global network is a key advantage for business customers of all sizes.

MCI® owns, operates, monitors and maintains one of the largest communications networks in the world. Our network facilities are throughout North America, Latin America, Europe, Africa, and the Asia-Pacific region, in more than 140 countries and over 2,800 cities.

Our 98,000-mile fiber optic network is designed to support the largest array of data communications and voice products in the world.

MCI owns the world's farthest reaching global network (based on company-owned POPs), and spans more than 4,500 Points of Presence (POPs) throughout the world, with 2.2 million global dial modems and high-capacity connections to more than 102,000 active buildings. The global IP network can circle the globe more than four times. Additionally, MCI remains the most connected Internet backbone provider with the greatest number of Autonomous System network connections. The company's expansive IP footprint, coupled with its direct interconnections, exceeds all other competitor networks and enables its business customers and ISPs to reach more destinations directly through MCI's global IP backbone than any other carrier.

MCI offers the fastest speeds available over IP today. We were the first to route and switch OC-192 IP network traffic. MCI also has the most scalable IP network available, offering speeds from dial to OC-48.

MCI's IP data solutions are directly built into a wholly-owned global network, for direct, safe, secure access.

Skilled technicians in Network Operations Centers around the world monitor the network for optimal efficiency 24 hours a day, 365 days a year.

Figure 6.30: Promotional description of MCI's network infrastructure. The style and content is emblematic of the form of marketing rhetoric promulgated by WorldCom throughout the 1990s bandwidth boom. (Source: MCI website, March 2005.)

6.5.3.1 WorldCom's network marketing rhetoric

Before examining a sample of the marketing maps produced by WorldCom, it is instructive to first consider the kinder promotional context in which they were typically embedded. This is best achieved by looking at the structure and content of the corporate website describing the network and how this frames the maps themselves. The March 2005 MCI[18] corporate website presentation is used as a representative exemplar.

The textual marketing narratives, unsurprisingly, describe the network in an emphatic fashion, stressing its capacity and extensive geographic reach (Figure 6.30). The tone of language used - dynamic verbs, fact-laden statements, 'punchy' phrasing - is textbook marketing speak. However, one can also see that this is carefully crafted language, for example with the conscious insertion of caveats and subtle qualifiers where necessary to avoid making factually false statements. The text is also peppered with engineering jargon, a direct call to scientific authority, signifying this as a technical sales pitch rather than a consumer one.

The narrative's primary aim is articulating that MCI's network as the best available, tapping into obvious rhetoric on size, scope, speed and so on (Figure 6.30). Archetypal claims include: "[t]he company's expansive IP footprint, coupled with its direct interconnections, exceeds all other competitor networks", "MCI offers the fastest speeds available over IP today." Other common marketing practices deployed by MCI in this narrative, include the claims that the company was the 'first' and is thus at the forefront of Internet development; that the company owns and controls the whole network; connoting that the company can meet all customer's needs – 'the complete solution'. Additionally, several statements directly outline the benefits to prospective customers, stressing not only 'biggest is best' but also security, reliability, and safety; for example, the closing assertion of the text highlights the fact that the network is monitored by skilled technicians to ensure "optimal efficiency 24 hours a day, 365 day a year." This kind of statement chimes particularly well in the current risk-averse climate of the so-called 'fear economy'.

Beside what the marketers choose to emphasise in the text, branding messages also work through what is left out. The most striking omission in this marketing statement is any mention of pricing. By not referring to low costs, the company is

[18] WorldCom re-branded itself as MCI in July 2002 following the bankruptcy.

positioning itself as a premium service that does not have to attempt to compete on cheapness. Also, omitted are customer testimonials.

Another core rhetorical strand underpinning the text is the stress on the global credentials of the company (thereby revealing clearly it's globalist business strategy). The word 'global' is used seven times and 'world' five times; emphasis is also given to the company's presence across the world with network facilities "in more than 140 countries and over 2,800 cities" (Figure 6.30). The corporation's marketing is clearly attempting to project an image of itself as being 'in the world' and positioned to dominate global telecommunications. The 'worldliness' of the rhetoric also implicitly offers the cachet of globalism to prospective customers and investors. The global rhetoric as a promotional device is very common in corporate brand marketing, particularly in IT, telecommunications and airline sectors (cf. De Cock *et al.* 2001; Goldman *et al.* 2003; Thurlow and Jaworski 2003). Indeed, being seen to be 'global' is often used as a key selling point to domestic buyers and investors. Clearly, if a company does not lay claim to be a global player in the age of globalisation one might question their corporate virility.

The network maps themselves were embedded on the 'Global Presence' Web page (Figure 6.31). The page directly spells out corporation's network sale pitch (what marketers call the 'unique selling proposition') to customers and, especially, investors, starting with the forceful opening tag line: "For reach, reliability, speed, and security, our global network is unparalleled." In just one line, the author tries to encompass pretty much all of the key product advantages. A hierarchy of maps from global to regional to national is then presented to the reader. The maps are directly cited in a process of 'virtual witnessing' (see chapter four) and "[f]or the experienced technical customer, they act as 'hard facts' to back up our marketing claims" (Ritson interview 2000). Essentially the invitation to the reader says: 'go on, look at the maps and *see* for yourself just how great our network really is'. This is the classic appeal to unimpeachable cartographic authority to justify the 'unique selling proposition' for the network. The evidential authority of the map is, itself, backed up by indexical 'facts' listed in the seven bullet points (Figure 6.31), that detail the 'strengths' in terms of some 'honest' engineering numbers. Overall, then the marketing materials are designed to convey a sense 'hard-headed' seriousness and technological competence, and to achieve this connotation they draw directly on the authoritative visual and narrative rhetoric of engineering, cartography and statistics.

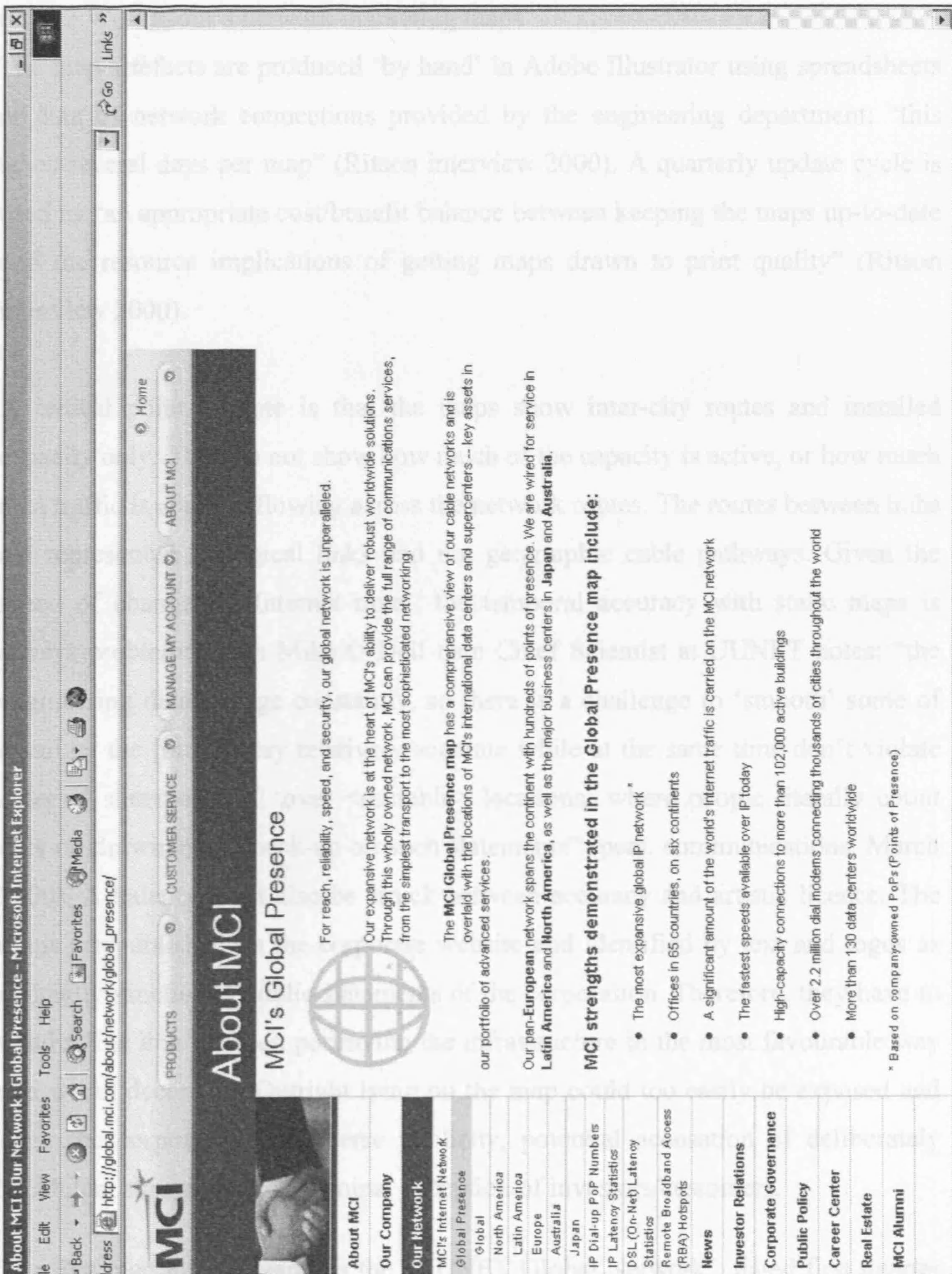

Figure 6.31: The promotional context in which network marketing maps are embedded on the MCI corporate website. (Source: author screenshot of MCI website, March 2005.)

6.5.3.2 WorldCom's network marketing maps

The map artefacts are produced 'by hand' in Adobe Illustrator using spreadsheets of data of network connections provided by the engineering department; "this takes several days per map" (Ritson interview 2000). A quarterly update cycle is used as "an appropriate cost/benefit balance between keeping the maps up-to-date and the resource implications of getting maps drawn to print quality" (Ritson interview 2000).

A critical point to note is that the maps show inter-city routes and installed capacity only. They do not show how much of the capacity is active, or how much data traffic is actually flowing across the network routes. The routes between hubs are represented as logical links and not geographic cable pathways. Given the speed of change in 'Internet time', the temporal accuracy with static maps is always problematic, as Mike O'Dell then Chief Scientist at UUNET notes: "the engineering data change constantly, so there is a challenge to 'smooth' some of detail so the [maps] stay relatively accurate while at the same time don't violate external statements of 'over <mumble> locations' where people literally count dots on drawings to check-up on such statements" (pers. communications, March 2000). A balance must also be struck between accuracy and artistic licence. The maps are published on the corporate website and identified by text and logos as officially sanctioned public statements of the corporation. Therefore, they have to tread a fine line between portraying the infrastructure in the most favourable way and wilful deception. Outright lying on the map could too easily be exposed and open the corporation to adverse publicity, potential accusation of deliberately fraudulent statements and criminal deception of investors/customers.

The first map in the sample is the "UUNET Global Network", dated first quarter 1997 (Figure 6.32). Although clearly identified through the UUNET logo, the network was a subsidiary of the WorldCom corporation by this point (see Table 6.4 above). In graphic design terms this is the simplest marketing map of the WorldCom set, being a muted black and white line art composition. It has a distinct engineering feeling about it and has many stylistic commonalties with ARPANET network maps (see Figure 6.3 above).

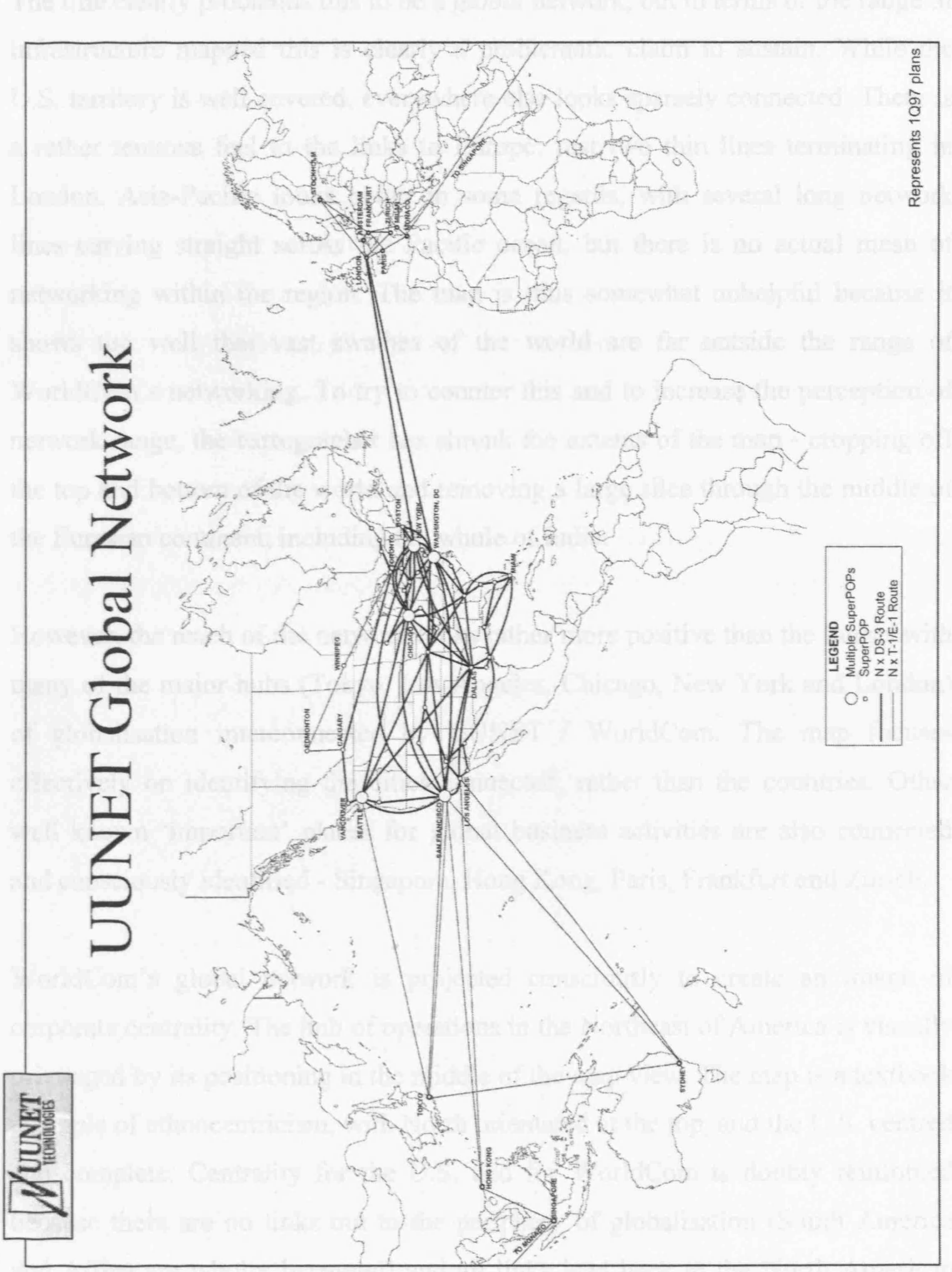

Figure 6.32: A WorldCom global scale marketing map showing the newly acquired UUNET backbone from spring 1997. (Source: Originally published on corporate website. No longer available.)

The title clearly proclaims this to be a *global* network, but in terms of the range of infrastructure mapped this is clearly a problematic claim to sustain. While the U.S. territory is well covered, everywhere else looks sparsely connected. There is a rather tenuous feel to the links to Europe: just two thin lines terminating in London. Asia-Pacific looks better in some regards, with several long network lines carving straight across the Pacific ocean, but there is no actual mesh of networking within the region. The map is thus somewhat unhelpful because it shows too well that vast swathes of the world are far outside the range of WorldCom's networking. To try to counter this and to increase the perception of network range, the cartographer has shrunk the extents of the map - cropping off the top and bottom of the world and removing a large slice through the middle of the Eurasian continent, including the whole of India.

However, the reach of the network looks rather more positive than the range, with many of the major hubs (Tokyo, Los Angeles, Chicago, New York and London) of globalisation interconnected by UUNET / WorldCom. The map focuses effectively on identifying the cities connected, rather than the countries. Other well known 'important' places for global business activities are also connected and consciously identified - Singapore, Hong Kong, Paris, Frankfurt and Zurich.

WorldCom's global network is projected consciously to create an image of corporate centrality. The hub of operations in the Northeast of America is visually privileged by its positioning in the middle of the map view. The map is a textbook example of ethnocentricism, with North orientated at the top, and the U.S. centred and complete. Centrality for the U.S. and for WorldCom is doubly reinforced because there are no links out to the periphery of globalisation (South America and Africa are wholly bypassed) and all links lead back to the North American heartland[19]. However, other core regions of the world economy are not connected by WorldCom's infrastructure.

[19] Except for a somewhat curious link between Monaco and Singapore, that does the uncomfortable cartographic trick of disappearing at one edge and then reappearing on the opposite side of the world.

In terms of the next two cartographic design strategies for promotional cartography, abundance and capacity, the performance of the 1997 map is mixed. The North American heartland appears at first glance to have an abundance of network routes criss-crossing it. However, on closer inspection it is apparent that many U.S. states do not have a hub and the lines cross over them without connecting. Outside North America, the network fares even worse - just four hubs in Asia-Pacific and only eight to cover Europe. The impression is not one of an abundant network throughout the world from this map, but one of a largely unconnected globe. The capacity of the network again looks relatively healthy for North America, with some well proportioned black lines representing what were at the time high-bandwidth DS-3 routes (45 Mbps) and fairly large circular hubs, but the international routes run at a much lower capacity (1 Mbps) and are mapped by rather spindly looking lines and dot-sized hub symbols that connotes a rather frail network overall.

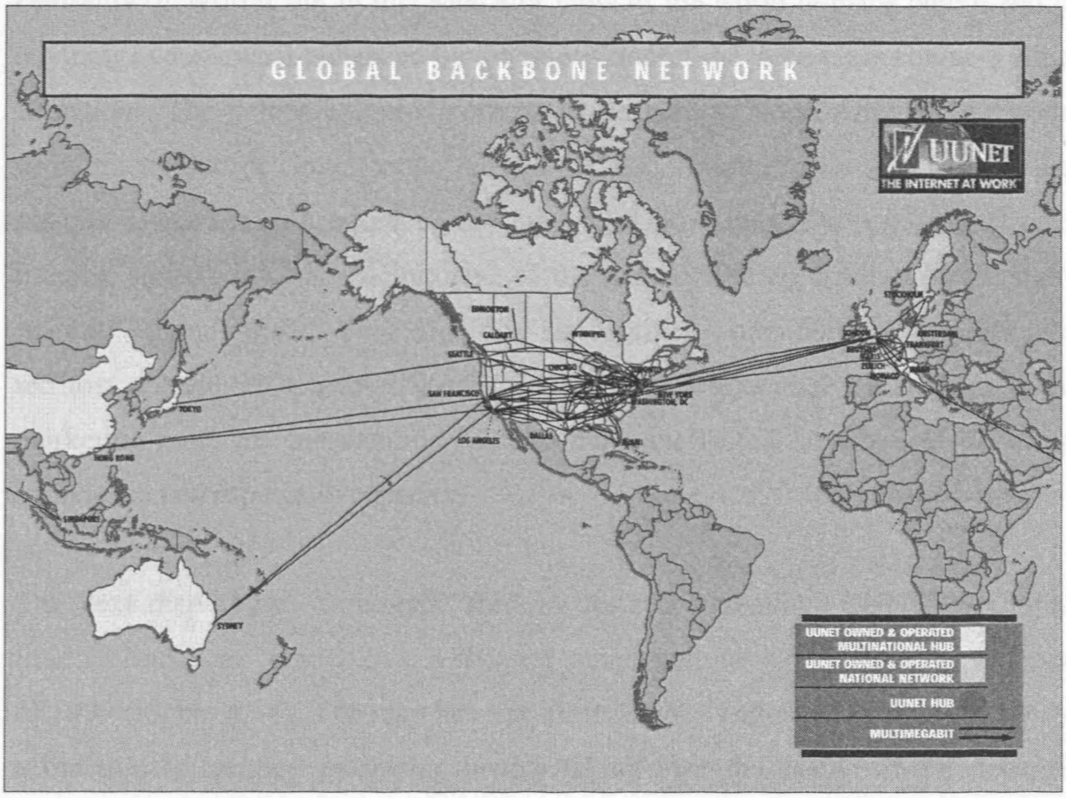

Figure 6.33: Global scale backbone marketing maps produced by WorldCom's UUNET backbone, May 1998. (Source: Originally published on corporate websites. No longer available.)

The next map in the sequence moves forward about a year, showing UUNET's 'Global Backbone Network' in May 1998 (Figure 6.33). This map is clearly the product of the same design approach as the 1997, however, the coloured version is arguably actually less effective than the black and white version it updates. The legend is somewhat simplified and the technical language is toned-down compared to the 1997 map.

Little has changed in terms of range of the network in that year. If anything, there actually seem to be fewer long links, particularly in Asia-Pacific (the dropping of links between Tokyo-San Francisco and Tokyo-Sydney being obvious). There are several more links across the North Atlantic but they are tightly clustered together. The lack of network range in the northern latitudes now also seems problematic, with the empty extents of Greenland and the Canadian Northern Territories drawn large (and exaggerated by the map projection). The corporate centrality of WorldCom in this Mercator view of the world remains potent and if anything is somewhat enhanced by the imposition of the three-class colour-coding of nations. The golden-coloured corporate heartland of North America and parts of Northern Europe comes to the fore on the map, followed by a select few beige nations deemed privileged enough to have a UUNET hub. The rest of the world literally shrinks into the background of the map by the application of the light 'natural' green wash. This signifies unidentified, unimportant, unprofitable territory outside the sphere of WorldCom's corporate concerns. Yet, as a network marketing map, the presentation remains quite ineffectual in terms of denoting abundance and especially capacity.

The next map shows a dramatic shift in design, presenting 'UUNET's Global Internet Backbone' draped over a stylised 'marshmallow' world, from the summer of 1999 (Figure 6.34). The map has lost all its clunky engineering legacies, likely a function of 'proper' marketing people taking over the design of the network maps, under the direction of Henry Ritson, at UUNET's office in Cambridge, UK (interview 2000). The design styling would develop over the next three years, but remain quite consistent in terms of colours, key symbology and fonts (see Figures 6.35 and 6.36 below).

In terms of demonstrating network range, the 1999 map is quite an improvement over the previous two examples. The somewhat unusual choice of projection means that many long orange-coloured route lines sweep from the west coast of the U.S. across the entire width of the map to reach the Asia-Pacific cities. These routes are represented by smooth curves which draw the eye along their full length from U.S. origin points to distant destination in the Orient. The lines are also spread apart, aiding range identification and increasing the perception of an abundance of routes. However, one must question the validity of this presentation of routes. Obviously, all route lines are generalised to some degree on marketing maps but they should probably be shown actually going in the right direction around the world! Additionally, showing routes in this way also unintentionally punctures further the globalist claims of the corporation, as the lines can be seen to pass *over* all of South America, Africa and India.

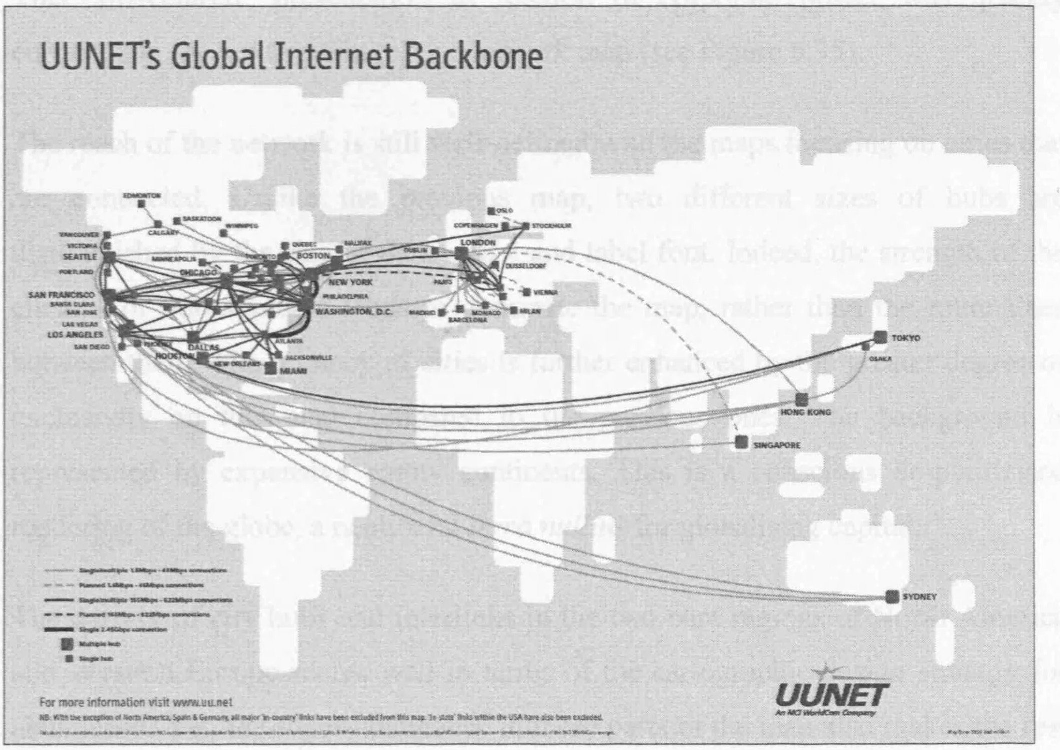

Figure 6.34: Global scale backbone marketing maps produced by WorldCom's UUNET backbone, June 1999. (Source: Originally published on corporate websites. No longer available.)

Unlike the two previous examples, the 1999 map shows the whole extent of the world (the dissected Indian landmass is restored). The projection is a 'one-ocean' viewpoint focused on the Atlantic, with the Pacific Ocean effectively disappearing at the margins of the map. This, in combination with the unification of the Eurasian landmass, creates clear problems for the persuasive presentation of a supposedly global network. The whole left-hand side of the map, stretching east from Stockholm to the Bering Straits, becomes an eye-catching vast white void, entirely un-penetrated by WorldCom.

These problems with map extents and the display of route range also impact on the sense of centrality in the overall presentation. The graphic centre of the map is now occupied by Western Europe. In a design sense, the overall map looks unbalanced - the dense left side appears to outweigh the empty void on the right. This 'off-centred' presentation in relation of corporate power was quickly corrected in the next version of the network map (see Figure 6.35).

The reach of the network is still well-defined with the maps focusing on cities that are connected. Unlike the previous map, two different sizes of hubs are distinguished by the size of the symbol and label font. Indeed, the strength of the clusters of hub symbols tends to dominate the map, rather than the route lines between them. The primacy of cities is further enhanced by the greater degree of exclusivity on this map compared to the previous ones. The background is represented by expansive empty continents. This is a conscious de-politicised rendering of the globe, a neoliberal *terra nullius* for globalising capital.

The density of city hubs and interlinks in the two core regions of North America and Western Europe scores well in terms of the cartographic design strategy for abundance. Yet, the super-abundance in these parts of the map also makes the rest of the world look more starkly empty. Pragmatically coping with such a large contrast is difficult; "You try and show a map of the world's Internet and you can't ever find a scale or legend which will cope with the differences in line density between Northeast of the USA and more 'Internet remote' areas" (Ritson interview 2000). The capacity of the network is better demonstrated in this map, with the use of thicker lines and inclusion of colour coding of routes by bandwidth. One can speculate as to whether the ambiguity in the representation of capacity has positive connotative impacts. Of course, the use of data classification to group diverse features together into a small number of categories is a common approach in statistical cartography (as noted in chapter five with regard to choropleth maps in particular). While classification is useful for simplification it also works to mask variability in the data. This masking could have useful benefits in marketing by maximising the impression of capacity because, without knowledge of the underlying data distribution, the map reader cannot tell how many of those bright orange-coloured lines are 45Mbps bandwidth and how many are really at 1.5Mbps - this is a not an insignificant difference in capacity, after all.

Moving forward in time by another year, we come to the marketing map of 'UUNET's Global Internet network' for June 2000 (Figure 6.35). The corporate fortunes of WorldCom were beginning to slide by this point, as the growth in capitalisation through the second half of the 1990s began to slow (see Figure 6.29 above). In overall design style, there is clearly a lot of common heritage with the previous map. However, some of the more radical elements in the 1999 design have been toned down. Most obviously, the centring of the map is changed to give North America back its 'rightful' (in terms of corporate power) privileged position. Also, the unusual bubble shaped rendering of the continental outlines in the 1999 map has been dropped in favour of more conventional geographic shapes.

In the same fashion as the 1997 and 1998 maps, the unified world is split and the 'Indian cut' is again made to shrink the extents of the Eurasian continent. There are a whole lot of long route lines, rendered in bright colours, across the pale blue North Atlantic and Pacific oceans. Most run arrow-straight and have been consciously spread apart to improve their legibility and also their potency in connoting range. The parallel track-like routes to Europe in particular seem to cover the whole ocean. The extra long route line from Seattle across the Pacific and down through the whole of China to reach Singapore is also demonstrative of extreme range. Linked to the overall impression of network range, UUNET's infrastructure now also appears to offer many more *direct* routes than in previous maps, especially connecting into European cities. All the improvements in the presentation of the range of the network in the June 2000 map are, however, more than offset by the complete failure to demonstrate the reach of UUNET's network.

The slightly larger scale of mapping employed and the growing density of network route lines and hubs means that the cartographer chose not to identify the cities. The simple removal of labels to improve legibility is actually problematic for persuasive communication, as readers cannot tell which 'right places' the network reaches. If one knows something of the geography of world cities, it is possible to make plausible guesses, but prospective customers and investors can not tell for certain which cities are connected. To the untrained eye, the scattering of red squares of the UUNET hub on the map now appear to be a random collection of points. Additionally, I would argue that without citing cities by name (and country borders as well) the visual-cognitive link between infrastructure and territory is broken on this map; the result seems like a disengaged network floating *above* the world, the network is rendered so exclusively that it does not actually connect with the world. This impacts directly and significantly on the power of map to conjure up the required sense of tangibility in reader's minds. The logical network in this map looks too virtual to be really real.

In terms of demonstrating abundance and capacity, this map also achieves mixed results. The underlying network has expanded greatly over the 1999 extents and there is an appearance of a denser meshing of links in the North American heartland and also in Europe. Indeed, the overwhelming abundance of mapped infrastructure, at this scale, completely smothers the Northeast U.S. and the San Francisco Bay area; as such it is counterproductive to cartographic legibility. The broader based growth of the route links in Japan, across Australia and branching down to Puerto Rico in the Caribbean are, however, useful additions for evoking an abundant, successful network. There are now so many links on most routes that the cartographer has chosen not to try to show them all, instead the overlapping presence of multiple links is indicated by placing small numbers ('x2', 'x3') embedded in the middle of the line. Whilst an acceptable pragmatic technical solution to convey information factually, it does nothing in terms of design strategies for marketing maps to evoke in readers the power of network infrastructure being built by UUNET. The result is that while the number of routes is many times greater than the year before, it does not look like it from the map.

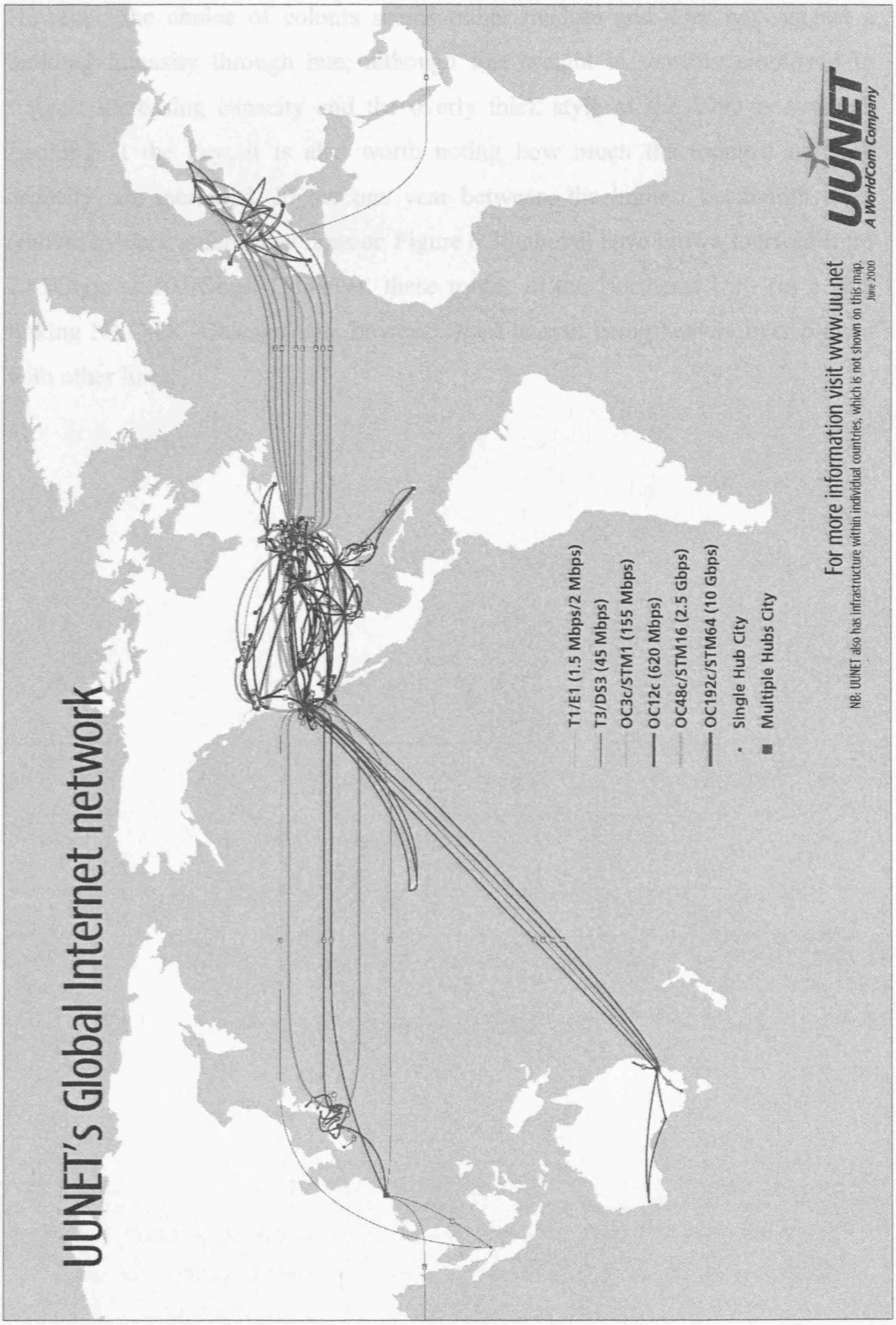

Figure 6.35: Global scale backbone marketing map of WorldCom's UUNET network, June 2000. (Source: Originally published on corporate website. No longer available.)

The display of route capacity is partially improved by using six different coloured-coded line categories instead of the three classes in the 1999 map. However, the choice of colours seems rather random and does not suggest a building intensity through hue; although line weight is sensibly employed to suggest increasing capacity and the overly thick style of the 1999 is avoided. Looking at the key, it is also worth noting how much the topmost network capacity has increased. In the one year between, the highest bandwidth links (shown by dark green route lines on Figure 6.35 above) have grown fourfold from 2.45Gbps to 10.0Gbps. However, these routes in the Northeast U.S. (in a ring linking NYC-DC-Chicago) are, however, hard to spot being heavily over-plotted with other lines.

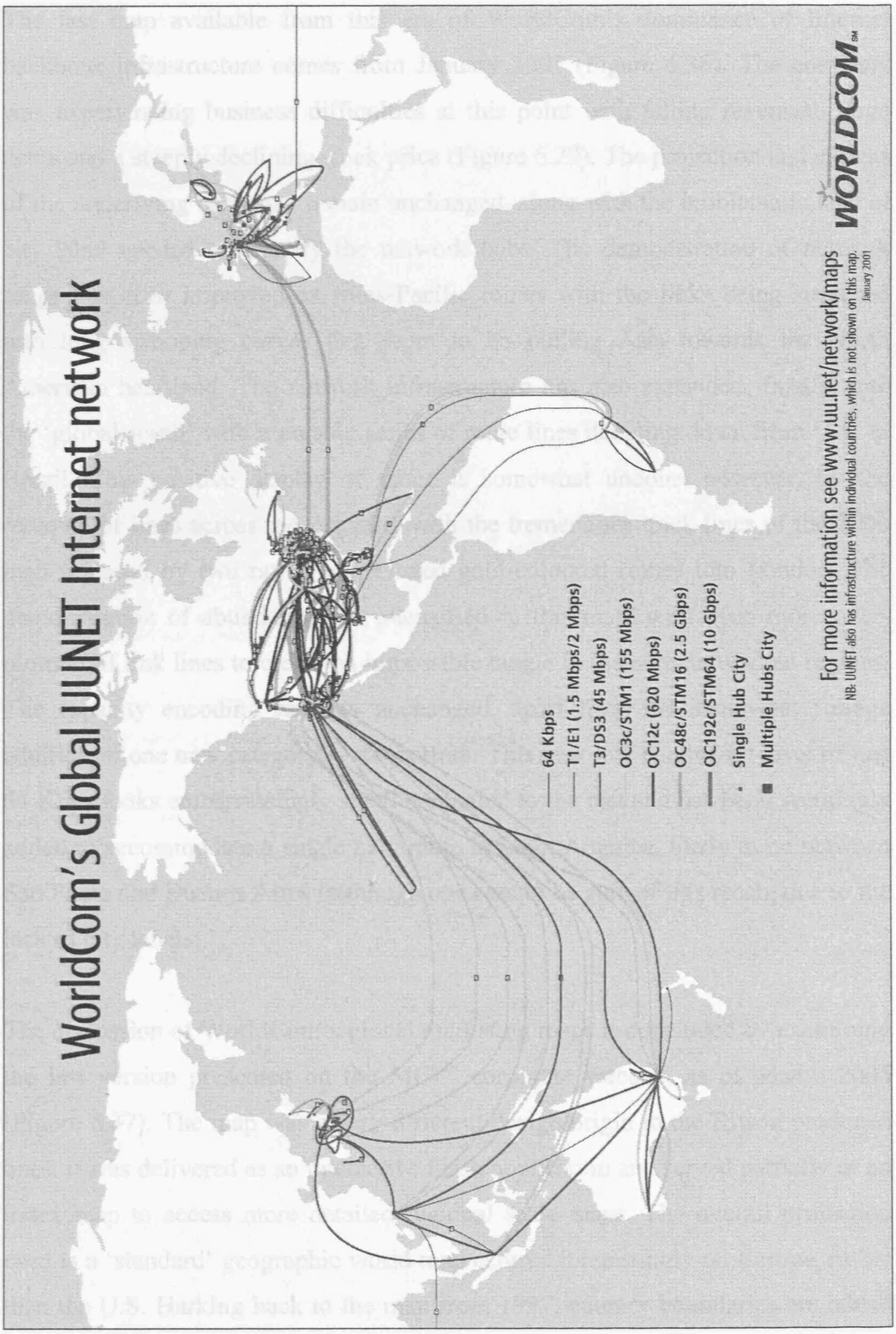

Figure 6.36: Global scale backbone marketing maps of WorldCom's UUNET network, January 2001. (Source: Originally published on corporate websites. 2001 map is no longer available.)

The last map available from this era of WorldCom's dominance of Internet backbone infrastructure comes from January 2001 (Figure 6.36). The company was experiencing business difficulties at this point with falling revenues, large debts and a steeply declining stock price (Figure 6.29). The projection and extents of the underlying base map remain unchanged, along with the problematic lack of city label needed to identify the network hubs. The demonstration of network range has been improved on trans-Pacific routes with the links being stretched into long swooping curves that seem to be pulling Asia towards the North American heartland. The network infrastructure has also expanded, finally, into the 'global south' with a notable series of route lines dangling down from U.S. to Brazil. This positive display of range is somewhat undone, however, by the removal of lines across the Atlantic, with the tremendous track-lines of the 2000 map replaced by two rather understated gold-coloured routes into London. The demonstration of abundance has intensified in this map, with even more over-plotting of link lines to create an impossible tangle in the core networked regions. The capacity encoding remains unchanged, apart from the somewhat strange addition of one new category at the bottom. This new low bandwidth level of just 64 Kbps looks embarrassingly small compared to the rest and has been seemingly added to accommodate a single new route in Latin America, likely to be between Sao Paulo and Buenos Aires (although one cannot be sure of this reach, due to the lack of city labels).

The discussion of WorldCom's global marketing maps is concluded by examining the last version presented on the MCI[20] corporate website, as of March 2005 (Figure 6.37). The map was a very different design origin to the Ritson produced ones. It was delivered as an interactive Flash application and served partially as an index map to access more detailed regional scale maps. The overall projection used is a 'standard' geographic world map centred interestingly on Europe, rather than the U.S. Harking back to the map from 1997, country boundaries are added back in. Indeed, of all the cartographic attempts to justify the claims of offer a *global* network, this map presents some of the most plausible evidence, with the

[20] This was the name WorldCom's post-bankruptcy corporate entity. The company disappeared as an independent entity having been purchased by Verizon in January 2006.

links into several countries in South America, to India and into Africa (admittedly only to two cities in South Africa).

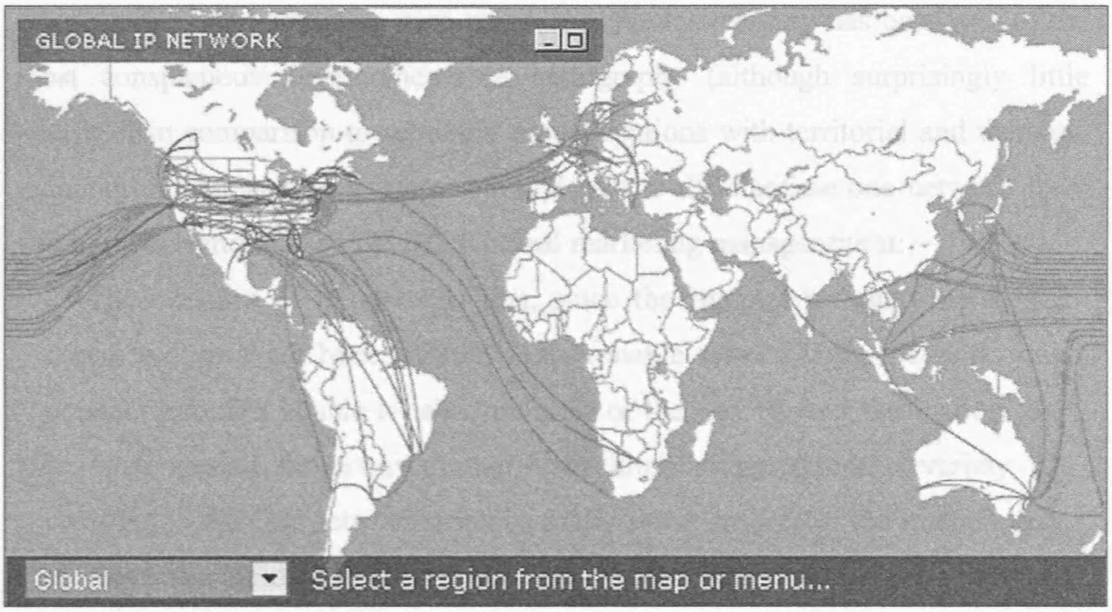

Figure 6.37: Global scale backbone marketing maps of the MCI network in March 2005. (Source: Originally published on corporate websites. 2001 map is no longer available.)

The map has a very much simplified symbology compared to earlier examples and there is no legend, logo, date, contact information or other corporate identification. In terms of identifying network reach, no effort is made at all, as no hub locations are indicated. Only two classes of network links are distinguished (green ones and orange-coloured ones), but it is not clear what their capacity is. Only in terms of demonstrating network range does the 2005 map score reasonably well; the links running down through the South Atlantic to South Africa are especially effective. The impression of range, however, is diminished because the Atlantic-centred projection necessarily splits the Pacific, so breaking the routes here in half. In this case utilising a world map with an equal area projection to denote their network would serve the company's marketing better.

6.6 The map and the myth

In conclusion, I want to consider the relationship between cartographic imagination displayed in the network marketing maps and the hype of Internet growth, particularly the 1990s myth that it was doubling in size every 100 days in terms of traffic flows. Cartography has long been created and consciously deployed to serve the exclusive and exclusionary interests of private capital. The emergence of the marketing map genre over the last century has been one of the most conspicuous developments in cartography (although surprisingly little analysed, in comparison to scholarly preoccupations with territorial and thematic mapping of nation-states). Maps are deployed to differentiate one network from another. As Henry Ritson, UUNET global marketing manager put it:

> "What we have to illustrate is that, since the Internet is 'many networks connected' you get better, faster, more reliable service if the network you connect into first is able to take you most of the way to your destination 'on an uncongested motorway' rather than hitch-hiking across a variety of crowded lanes. Our network maps basically show the area of the Internet that we have the ability to manage directly - and if we are managing it we can maintain high quality of service ..." (interview, 2000).

Internet infrastructure marketing maps are also as much about impressing investors as luring customers from competing networks. By analysing network maps, such as sequence published online by WorldCom, it was demonstrated that marketing maps attempt to denote the strengths of a infrastructure to investors and differentiating it from competitors through eight distinct cartographic design strategies: range, reach, directness, centrality, abundance, capacity, silencing and exclusivity. However, it was also apparent that they had mixed success in tapping into these eight strategies in a connotative sense. As such, the analysis present here demonstrates the real difficulties in effectively mapping Internet infrastructure even when the interest being served is dedicated exclusively to commercial persuasion without the need for objectivity. The most significant failing in the maps overall was the all too obvious mismatch between the claims of corporations to offer a global network service and the mapped reality of their infrastructure that barely covers a third of the world in terms of area (although they do probably connect the majority of the significant population from the business perspective). The overall connotation is that much of the world remains out of their reach.

Despite the design failings in the maps, they are produced frequently by corporations and often prominently displayed on the website, and are obviously an integral part of the company's marketing message (as shown by the analysis of fifty corporate websites; see Table 6.1). The maps' primary goal is to justify bold marketing claims by providing attractive and authoritative visual proof of the extent of the company's network. The maps draw on the reserves of cartographic *gravitas* - people tend to believe what they see on the map as real, particularly when it is shown using familiar framework of a Euro- centric world projection. At least three distinct truth claims can be discerned from the use of cartography in service of Internet infrastructure marketing:

(1) 'Biggest is best': The maps can prove, better than other rhetoric devices, that the network is as large as is claimed. One can see it really does connected continents, link all those important cities, span oceans. The expansive scale of the network as demonstrated beyond doubt on the map implies a successful company.

(2) The network is made tangible through the map. The rendering of invisible, unknowable, virtual network links into real lines inscribed onto a familiar landscape connects customers instinctively to the infrastructure (as discussed in chapter four). As Ritson commented: "The Internet is such an intangible concept for people that it is easy for them to assume that whichever Internet provider they choose, they will still connect to the 'same Internet'.... The network maps show what the infrastructure really is" (interview 2000). Of course, the map can show this with particular emphasis to make it look rather more than it is.

(3) The third and most important truth claim is that of *trust*. The network, when mapped must look permanent, safe and trustworthy. The backbone marketing map connotes: 'we are here to stay. Look at all the infrastructure we've built. You can trust us with your precious data.'

In relation to WorldCom case study it is now apparent that faith in this corporation generated by cartographic trust was misplaced. Events happening *off* the map fatally damaged the truth claims made on the maps. Despite having the biggest Internet backbone, WorldCom went bankrupt in July 2002. More widely, the crash of the telecoms sector in 2002 exposed the hollowness of the hype that underlay all those marketing maps. The maps were born out of the myth of internet 'traffic doubling every 100 days' and they were also an element in promulgating this mythical narrative. They were visual, irrefutable, cartographic prove of the growth happening and the need for more and more bandwidth. Ritson himself repeated this mantra in relation to WorldCom:

> "the network has been growing at 1000% per year for several years now. The map can go significantly out of date in a week. It is a terrifying moving target. I'm not even sure if anyone has ever had to map anything that grows this fast before." (interview 2000).

Of course, the maps in the late 1990s may have been connoting great traffic growth but they were not actually denoting that. They were showing the speculative building of infrastructure. They denoted more and more bandwidth, but investors could not see (and some probably did not want to see) that all those thick gigabit route lines were only half full, a quarter full, had only a trickle of data on them or were actually empty. It was easy to believe that maps were showing growth in demand - after all, why would a commercial company be building links between cities if they did not have the traffic to fill it? Airlines do not fly with empty planes, why would backbones networks be running empty pipes - and then spending billions building yet more pipes?

Basically, WorldCom were claiming to be installing much more infrastructure than they actually needed to hide losses and artificially boost revenues. They gave the impression of carrying much more traffic than they actually were. "[WorldCom] routinely counted fiber-optic capacity as traffic, rendering the statistic essentially worthless as a barometer of the Internet's growth" (Dreazen 2002, no pagination). WorldCom's backbone maps were complicit in this deception, they were compliant in mis-selling the nature of the demand.

Although, accusing the maps per se of misleading is disingenuous at another level. The maps were doing what they were supposed to be doing. They *were* marketing maps, not independently-produced, informational maps, and made no pretence at denoting traffic. Indeed, within their own parameters and agenda of marketing they were accurate and in some senses honest. It was just that there was no other source of information - so people believed the claims of doubling growth every three months and took the maps that were available (and pushed out by companies) as credible and cartographically trustworthy evidence[21].

What of the Internet infrastructure business now the dust from the 2002 crash has settled? Well it is still there - the Internet as a whole did not miss a beat and still continues to grow at a healthy rate. WorldCom, however, has vanished as rapidly as it appeared. The tainted name itself was erased when the corporation emerged from bankruptcy in April 2004 as MCI. At the start of 2006, MCI was to be acquired by Verizon, a major U.S. telephone company, for a mere $5.3 billion. Meanwhile, Bernie Ebbers, the former chief executive of WorldCom was found guilty in federal court of orchestrating the fraud and in July 2005 received as 25 year jail sentence.

[21] Indeed, the marketing maps from ISPs in this period have been exploited as credible evidence in a good number of academic studies on Internet topology and growth (e.g., Malecki 2002, 2004; Townsend 2001) and for policy analysis (e.g., OECD 2002).

Chapter Seven

Conclusions:
The Cartographic Imagination of Cyberspace

> [T]he domains that explorers chart, and the maps they produce, open up territories to interests that view them differently ... be they gold deposits or stands of timber or dispensable human cultures. The maps serve as the groundplan, the blueprint, the graphic agenda for subsequent exploitation.
>
> -- Stephen S. Hall, *Mapping the Next Millennium*, 1992.

> How many maps, in the descriptive or geographical sense, might be needed to deal exhaustively with a given space, to code and decode all its meanings and content?
>
> -- Henri Lefebvre, *The Production of Space*, 1991.

7.1 Introduction

In conclusion, I would argue that this thesis, along with the wider research into cybergeography I have undertaken, has made three contributions to understanding the evolving forms and functions of cartography in terms of: (1) showing how cyberspace cartographies are new, significant politically in the work they do, and as such are worthy of examination; (2) applying a semiotic reading of meanings and critical cartographic deconstruction of a range of novel empirical case studies; and (3) revealing valuable information about how cyberspace has developed and its varied spatial characteristics as seen through the cartographic imagination created to make it visible and tangible to different audiences.

7.1.1 Why do cyberspace cartographies matter?

I have argued that cyberspace cartographies are important because they chart new virtual spaces of human interaction and economic transaction, and they are deployed in service to powerful interests that seek to shape what these spaces will be like in the future. They are active components in many wider-ranging cyberspace discourses, in large part because they create potent imaginable geographies for virtual media and hidden infrastructures that are otherwise intangible and hard to comprehend. (The two major discourses analysed in chapter five and six were role of the Internet in development as represented in statistical maps and the commercial promotion of Internet infrastructure performed through marketing maps.) As explained in chapter four, the impact of spatial metaphors and geographic representations on the perception of what cyberspace looks like, how it works and what it can do, can be quite profound precisely because it is essentially an invisible infrastructure. Their production and consumption occurs in various settings, for example, many cyberspace cartographies are used operationally to document network structure, as inscriptions to virtually witness online experiments and measurement, or as means of the legitimising results of policy analysis. Many more maps of cyberspace are used strategically by business interests, as the 'blueprints' and 'groundplan' for commercial exploitation, to use Stephen Hall's phraseology from the quote above. Most significantly, like all maps, cyberspace cartographies, regardless of their declared purpose, have an impact in shaping how people perceive cyberspace, and as such need to be subjected to academic analysis, considering both how they work semiotically and also what power they have in the wider world in terms of effecting change.

Furthermore, cyberspace cartographies are increasingly prevalent and should be seen as a distinctive aspect of contemporary mapping practice and part of wider visual cultures. Yet, it is also important to recognize that the maps of cyberspace have multiple and sometimes unstable meanings which makes academic interpretation and deconstruction challenging. In the main case study chapters, the analysis focused on the semiotic strategies adopted by the mapmakers in discourses of development and marketing, drawing a distinction between the denotative and connotative uses of cartographic symbolisation to effect particular kinds of meanings. Such an analytical route can be profitable, but as Vujakovic (1999a, 4, original emphasis) tellingly notes from his work how the news media exploits cartography: "[c]are has to be taken to not read too much, *or* too little, into cartographic images. Any apparent contradictions between a map and the discourse in which it is embedded may reflect the limitations of cartography as a representational medium, ... rather than a hidden agenda or internal tensions within the discourse itself. We may, however, be equally tempted to treat the medium as *too limited* (especially if restricting analysis to linguistic approaches) and ignore the (visual) subtleties of the form."

Furthermore, another reason why cyberspace cartographies merit scrutiny by cartographic scholars is because, by and large, they are produced outside the mainstream map-making industry. In some senses, then, they are a challenge to established knowledge and practices but also, I would argue, an opportunity for cartographers to gain insights and novel ideas on map ontology and mapping epistemologies. As discussed in chapter three there are many new groups and individuals becoming active as map-makers to meet their needs to represent and understand cyberspace. (Although, the authorship of the most significant elements in the cartographic imaginary of the cyberspace originates from the United States predominantly.) Cyberspace cartographies, I feel, are a key part of a larger contemporary reinvigoration of creative mapping practices, as well as popularising new map uses. They also open up new scope for resistance to established representations of space as more people are empowered by fashioning their own maps rather than consuming predetermined cartographic products (cf. Sui 2008 for discussion of the implication of the new 'wiki' ethos of user-generated content to the GIS industry).

Whilst in some respects the shifting power of authorship is creative and empowering, there are also serious questions about the effectiveness of many of results in normative terms of design quality, intelligibility, accuracy and more general appreciate of aesthetics. Given the unstable meanings, it is also important to keep in mind when interrogating the maps that the mapmaker, or the mapping institution, themselves may well not be cognisant of the implications of particular design decisions made. In some cases denotative choice in design and symbology produce connotative meanings that are not at all what the mapmaker would have intended. This is evident in projection selection for many of the world maps used to display network infrastructure for marketing purposes that diminish the connotative sense of the corporations coverage of the globe (chapter six). Acknowledging such unconscious failings in mapmakers and their unintended impacts is not new of course (cf. Wright 1942), but poor projection selection persists even with people who, one might think, would know better, geographers writing undergraduate textbooks (Vujakovic 2002b). So the mismatch between denotative intentions and connotative outcomes in cyberspace cartography should not been seen as necessarily implying a 'hidden agenda' to deceive, yet it can still have serious implications for how readers (mis)interpret the mapped world.

Besides questions of effectiveness and imperfect understanding of connotative meanings by authors, it should also be acknowledged that the drawing of maps of cyberspace - even empowering, counter-hegemonic ones - are also acts of boundary-making, which inevitably contribute to the commodification of virtual spaces in the service of some particular interest or set of interlocking interests. Once cyberspace is mapped, it is changed. The nature of space becomes known, exposed for others, made available as territory that can be exploited, often in ways not anticipated or welcomed by user communities. New forms of mapping can all too easily open up cyberspace to a new kind of surveillance, revealing interactions that were previously hidden in unused log files and databases. The act of mapping itself may constitute an invasion of privacy of individuals and impinge on community rights. If the appeal of some virtual spaces is their anonymity, then users may object to it being placed under wider scrutiny, even if individuals are unidentifiable. In some senses, these maps may work to shift the spaces they map from what their users consider semi-private spaces to public spaces, and thus the maps may actually change the nature of cyberspace itself. As Smith (1999, 211-212) points out, reflecting on his own research ethics in mapping online discussion space: "[t]he bright light of social science research can create an unpleasant glare for participants drawn to a dimly lit online space." Thus, it is important to consider the ways, and the extent to which, cyberspace cartographies are 'responsible artefacts', which do not destroy what they seek to represent or enhance.

A desire for totalising knowledge of a territory (real or virtual), with mapping as a logical, necessary process is long standing characteristic of capitalist political-economy, as Stephen Hall's quote at the beginning of the chapter nicely encapsulates. Many of the most effective examples of cyberspace cartographies can be critiqued for their active role in expansionist rhetoric and technological hyperbole, a naïve faith in the inherent beneficial nature of economic growth and capital accumulation flowing from opening up online space. For example, driving an unsustainable building bubble in network infrastructure in the 1990s exploited maps to show where the investment was going, to make the construction programs tangible, to make the dreams of growing market share and future profits seem much more likely to come true. The infrastructure marketing maps in of that time were part of the proof that the Internet 'doubling every 100 days', yet such exponential network traffic growth turned out to be a myth and the predicted fortunes from selling bandwidth were millennial hubris (see chapter six for further discussion).

While visions that represent an alternative to the development of the 'virtual frontier', based on communitarian values rather than capitalist imperatives, are manifest in some cyberspace cartographies, these have a much lower profile. Moreover, these tend towards the utopian, being underwritten by 'one network - one world' idealism that all too often naively denies the importance of place relations. The reality is much more contested and contestable, with evidence strongly indicating that cyberspace is yet another technological layer which replicates and reinforces existing inequalities and power structures within societies and between different regions and nations. The crucial issue to bear in mind here, is that the maps do not just represent capital accumulation or social difference, but are active in their ongoing reproduction, including in cyberspace. This is one of the core themes that have resonated throughout the discussion in the case studies, in the analysis of marketing maps of commercial networks (chapter six) and the statistical mapping of Internet globalisation (chapter five).

7.1.2 Critical theorisation of cyberspace cartographies

I have defined cyberspace cartographies in three distinct modes, following Edney's (1993) non-progressive theorisation of map history. The modes are: maps <u>of</u> cyberspace, which are maps that describe cyberspace as a phenomenon from an external perspective, maps <u>for</u> cyberspace, which are interactive maps and spatialization for navigation within virtual spaces, and lastly maps <u>in</u> cyberspace, which are conventional (terrestrial) cartographic representations that have been transmuted through online presentation. The focus of the thesis was primarily on the first mode, particularly in the case study chapters.

The analysis of maps of cyberspace concentrated on in-depth case studies of Internet infrastructure mapping. This was situated conceptually within contemporary cultural analyses of representational practices, employing a hermeneutic epistemology that sought, both, to understand the semiological nature of the map designs, and also expose the power of the maps as texts. As discussed in chapter two, I interpreted these maps of Internet infrastructure as sets of signs with complex denotative and connotative meanings and as expressions of power/knowledge of new infrastructure spaces. As such the act of envisioning Internet infrastructure can never be unbiased and objective, it is always a social construction that connotes multiple meanings and that serves the interests of some groups. Maps are thus the products of privileged and formalised knowledge and they also produce knowledge about the world. Map construction, dissemination and use, therefore, must also be read within political-economic milieu. As Harpold (1999, 5, original emphasis) argues: "[t]he lines of force defining information flow in the networked and unnetworked spheres are not merely geographical or technological; they are also – irreducibly – *political*".

As discussed in chapter two, such critical theoretical approaches to cartographic texts as expression of power have been well developed over the last ten to fifteen years, but have most often been applied in historical contexts to untangle the power that infuses old maps. Virtually all empirical work by Edney, Pickles, Crampton, Harley, et al. deconstructs by looking backwards, which in some senses presents easier targets and with less at stake in relation to contemporary political relationships. The present thesis is innovative in the application of the theories in a forward looking way, a productive act of map deconstruction to reveal the 'power' of cyberspace mapping, unveiling its purposes, the interests served and social implications of this new mode of mapping.

Yet, there has been very little socially-informed analysis of cyberspace cartographies. And as was noted in chapter three, most analysis focuses on technical aspects and design performance rather than interpreting semiotic meanings and political ideologies. This thesis, along with my other publications on cyberspace cartographies (see appendix one), has played a role in building understanding of the social effects of these new maps and spatializations. At another level, this thesis has sought to move beyond thinking epistemologically (the techniques for mapping the Internet), to focus ontologically on what aspects of the Internet infrastructure are chosen to be mapped, which are ignored and which are deemed un-mappable. As the Lefebvre (1991) quote above suggests, an almost infinite number of possible maps would be needed to fully encode and decode meanings of a given space, yet only a small percentage of possible maps are every actualised and an even smaller number enjoy wide circulation and have the power to effect change in the world. It is important to realise that much else is unmapped and that this has political implications, not just pragmatic limitations. The discussion in chapter five on how people have tried to measure and map Internet globalisation highlighted this. The choice of what to map can reveal as much about the cartographer as how they actually seek to represent it (allowing for the instability of connotative meanings and the uncertainty of the intentions lying behind design decisions discussed above).

7.1.3 What is revealed about cyberspace?

Through critical interpretation, focused on connotative meanings and social power, I revealed new details on the nature of Internet infrastructure and the spatial nature of cyberspace more generally. At the same time, the analysis provided insights into the worldviews and agendas of the map-makers themselves and the institutions they work for. As chapter four discussed, maps of infrastructures shape perceptions of the reality of the Internet by making its invisible routes and flows visible and aiding the analysis of its uneven geographic structures across different scales and seeing the spatial effects on interaction and mobilities.

Internet infrastructure maps do important, and sometimes counter-intuitive, work puncturing the spaceless rhetoric of cyberspace. In their denotative representation of 'what is where', they connotatively counteract the deterministic 'death of distance' notions by demonstrating that place matters in the so-called Network Society (Castells 1996). Despite the virtualised rhetoric, the socio-technical assemblage of the Internet remains embedded in real places and maps are effective at denoting the intersections between cyberspace and geographic space. Even maps in the services of Internet promotion, show the discontinuity in infrastructure provision as much as the coverage, particularly in the ongoing inequalities between core and periphery at the global scale (chapter six). Location remains crucial in terms of political and cultural contexts – for example territorially defined freedom of expression and privacy rights - and the geopolitical power of the nation-state still holds sway in much cyberspatial interaction. This is very evident in the ways institutions and individuals have mapped statistics on the worldwide growth and diffusion of the Internet into a framework of countries rather than flows of traffic between places and through borders. Although this is not unusual, because Vujakovic (1999a, 4) notes, "[c]artography is an excellent medium through which to represent spatially distinct areas (legally defined territories), and lines (national borders), but less good when it comes to 'fuzzy' boundaries (culture regions), or intersecting and overlapping 'classes' of information (dialect groups, religious affiliations, etc.)." It is also apparent that the intersections and overlaps of aspects of cyberspace make it hard to represent cartographically.

7.2 Infrastructure mapping and the importance of the technical

This thesis has taken the object of the infrastructure map as the prime vehicle for the wider political interpretation of the Internet and, simultaneously, as a notable signifier of the new era of the Network Society (Castells 1996). Seeing the possibilities and the partialities of map representations of infrastructures of the Internet can assist people, I think, in the realisation that the technical is not natural or pre-given. Breaking through the cultural naturalisation of everyday technologies to see that the technical is a political project is vital for a more nuanced understanding of the socio-spatial effects of the Internet. This kind of approach can be categorised as materialist media studies, which, Thacker (2004, xii) argues: "shows how the question 'how does it work?' is also the question 'whom does it work for?'. In short, the technical specifications matter, ontologically and politically." Within this notion of 'technical specifications' one should include all manner of infrastructure maps. Interrogating the connotative meanings created by maps of infrastructure, therefore, does not merely show 'how the Internet works' but begins to disclose 'whom does the Internet work for'. This is an important and worthwhile project, given the degree to which the Internet is fast seeping into everyday life and is already slipping into the cultural background in developed countries.

In addition, while the topic of Internet infrastructure might seem narrowly drawn, it actually raises many substantive questions in the creation of effective and legible cartography. Understanding infrastructure is a conceptual and representational challenge, in large part because of its invisibility and lack of definite metaphors. I described several dimension to this in chapter four - materially hidden and unseen activities, taken-for-granted background services and institutional obscurity. Infrastructure is something you notice more by its absence than its presence, it is a kind of 'second nature' according to Thrift (2004, 584), "the surface on which life floats."

The potency of cartographic imagination was examined in terms of how it works to make the invisible Internet infrastructures visible, but in certain ways, with certain kinds of connotative meaning. Firstly, for general audiences, the power of verbal and visual geographic metaphors was considered. Part of the capacity to influence enjoyed by some of these metaphors (for example, organic form of abstract network graphs; Figure 4.10) comes from the way they conform to what people *expect* the Internet to look like. Visual metaphors are typically chosen deliberately to reinforce existing preconceptions, thus it is easy to understand how people willingly accept certain kinds of maps and diagrams as 'natural' pictures of the actual Internet, rather than entirely contrived images.

Secondly, for the research-engineering audiences, the significant role of scientific inscriptions in constructing 'matters of fact' about the Internet's structure and operations was demonstrated. The theory of virtual witnessing was used here to understand the mechanism for creating credible connotations using particular kinds of denotative strategies. Many Internet infrastructure maps are part of the lineage of 'scientific illustrations', which includes architectural plans, engineering blueprints, anatomical drawings and statistical graphics. The value of infrastructure maps produced by scientists is not in what they show, so much as in how they show it, to make the Internet a plausible, a known, a measured artefact. They are able to convince others 'at a distance' of the matter of the factual reality of the infrastructure.

As Latour and Woolgar (1979, 243, original emphasis) note from their laboratory ethnography: "Scientific activity is not 'about nature', it is a fierce fight to *construct* reality." The infrastructure maps construct the Internet scientifically, they construct it literally as a visible reality. (This also applies to the cases of worldwide Internet globalisation and network marketing which are made real through the representational acts.) Yet these messy (social) processes of construction should themselves be invisible to maintain the impression of scientific objectivity. The result is an authoritative illusion that the Internet is a natural phenomenon from which scientifically measurable objects are simply 'discovered', rather than manufactured: what the science and technology studies literature calls the 'ship in the bottle' conceit, which then presents complete Internet 'facts' as if found fully formed.

7.3 Case studies in infrastructure mapping

The empirical core of this thesis has comprised two case studies in cartographic imagination of Internet infrastructure. These unpacked distinctive visions of what the Internet looks like and what various interests want it to become. The case studies were not designed to give synoptic coverage of cyberspace cartographies[1], but sought to provide in-depth portraits, highlighting the connotative meanings and the power of maps for imagining particular aspects of Internet infrastructures.

The case studies analysed maps that purposely work as 'representations of spaces' (Lefebvre 1991, 233). They are formalised works of planners, statisticians, engineers/technocrats and marketers that attempt to structure everyday social life through rationalised, organised, and commodified

[1] The range of my publications, as part of the larger cybergeography project, does provides comprehensive coverage; discussed in appendix one.

(re)productions of spaces. In terms of visual form they were recognisably cartographic - they were static, planar maps based on a geographic framework generally using established design conventions.

A key part of a hermeneutic approach to cartographic analysis is to break down the superficial anonymity of viewing map artefacts as a distanced audience, and to begin to understand the context and power relations involved in their authorship. In terms of authorship, the cartographic imaginary of Internet infrastructure examined in the case studies arose from a distinctive set of institutional contexts. Significantly, none were produced by trained cartographers working within recognised cartographic institutions, such as a national mapping agency or a commercial mapping company - reflecting that much of the authorship of maps of cyberspace is happening in new contexts. Chapter five's statistical maps were produced by academics, artists, activists, and also technocrats working for international agencies and designers employed by U.S. magazines. Chapter six's promotional maps were produced in the marketing departments of major Internet infrastructure corporations, typically by unnamed graphic designers and illustrators. It is apparent that the cultural-linguistic setting of these cartographic visions of the Internet is Euro-American because of the domination by these institutional contexts (academic, corporate and governmental).

All the maps examined in case studies were disseminated free of charge and were publicly available. In terms of the mechanism of publication as graphic artefacts, some of the statistical maps in chapter five were published conventionally in print (magazines, official reports and academic articles) and others were designed to be solely delivered online. The marketing maps analysed in chapter six were all published wholly through the web (although some have no doubt also been physically printed in various outlets to meet particular needs, e.g., promotional brochures). The media of presentation for the statistical maps were digital files (colour raster graphics and postscript), the marketing maps were all digital files primarily in PDF format and also Flash animation.

7.3.1 The statistical cartographic imaginary

The first case study explored how statistical maps of Internet work semiotically and politically to produce a particularly kinds of imaginary of the worldwide Internet globalisation. The analysis examined eight different maps in detail. While they all premised upon the dominant geopolitical framework of nation-state as their units of measurement and representation, they produced a range of viewpoints onto the world. In many respects their reliance on this nation-state metageography is both a conceptual and design shortcoming, however, in other respects these maps are successful in creating a compelling cartographic imaginary of the worldwide status of the Internet because they play to these established conventions. In addition there are still relatively few other kinds of maps produced which offer a competing synoptic - and one might say seductively simple – a view of the Internet on a single page. Most other maps and visualisation tended to be more technical in nature, showing specific company's infrastructures denoted as link-node graphs (as in chapter five).

There are few statistical maps of the 'whole' Internet, so the ones that exist are powerful. The empirical examples included maps, such the 'International Connectivity' and DOI maps, which are some of the most widely seen geographic maps of Internet infrastructure and enjoy an influential position as 'immutable mobiles' (Latour 1987), securing a particular imaginative geography of Internet globalisation through their denotatively conventional and clear visual narrative design. They employed a range of different area-based thematic map designs, but they nearly all exuded a recognisable techno-scientific aesthetic, as they sought objective authority through an unadorned, sparse and perfunctory style of representation. (Scarponi's flag-based cartogram was the one noticeably different case.) The maps are typically presented intertextually as a 'matter of fact' envisioning the Internet using semiotic strategies of scientific inscription. Of course, this denotative 'simplicity' in their design was in part due to expediency in production but it had political consequences in how people perceive Internet globalisation.

To make sense of the sample statistical maps of Internet globalisation, in semiotic terms, a simple fourfold classificatory model was used to characterise them according to their overall connotative meaning. The classification was formed by two dimensions of meaning, 'difference' between nations (evident in denotative signs) and the 'complexity' of the patterns (denoted at scales from local to global). In diagrammatic form these two dimensions were drawn as axis running from low-to-high, forming a grid of four quadrants. These quadrants are connotative meanings for four separate classes of map: orderly representations (lower 'complexity' with higher 'difference'), divergent representations (higher 'complexity' and higher 'difference'), disorderly representations (higher 'complexity' with lower 'difference') and, lastly, convergent representation (lower 'complexity' and lower 'difference').

The case was also made in chapter five that there are two broad, and competing, discourses that seek to 'explain' the relation between the Internet and ICTs and the prospects for fostering economic and social development across the world. These were termed 'diffusionists' for organisations and individuals who see basically positive relations, with the Internet being empowering and able to foster progressive development, and the 'divisionist' institutions and activists who are sceptical and highlight the negative consequences flowing from a developmental model premised on the Internet and ICTs. In terms of the fourfold model, the maps classified, according to their overall connotations, as orderly or convergent are arguably likely to envision the world statistically in ways that are supportive of the 'diffusionist' agenda. In opposition, the divergent and disorderly map categorises are more likely to have connotations that would be advantageous to the 'divisionist' perspective on Internet globalisation. From the eight maps analysed connotatively, three were assigned to classes supportive of the 'diffusionists' and four were categorised as 'divisionist' representations of the world. One map, Scarponi's flags cartogram, could not be assigned neatly into one or other camp because it displays ambivalent connotations that are both divergent and convergent.

The three 'diffusionist' categorised maps were created primarily for the cause of securing wider network connectivity in poorer parts of the world. They are working tools of techno-missionary efforts to connect up the 'unwired' nations by Internet pioneers and development bureaucrats. Enhanced Internet capacity will also be beneficial for capital in securing access to new markets and emerging economies.

The final 'International Connectivity' map created by Landweber in 1997 and ITU's DOI map were both classified as strongly convergent, connoting gradual and limited degrees of inequality between countries (low on difference dimension) and overall consistent pattern across the world (low on the complexity dimension). It was also demonstrated how they are a problematic representation of Internet globalisation, demonstrating many common problems with choropleth maps, in terms of zone selection, the occlusion of geographically small areas, ecological fallacy and grouping bias. The connotative effect is the production of authoritative looking images, ones that epitomises the imposition of the normalising 'statistical' vision onto the world, ordering rhizomatic processes of Internet globalisation into country-based units and a rigid hierarchy of classes. The outcome, I would argue, is that these convergent statistical mapping of Internet infrastructure work to 'lockdown' the complex, multi-vocal processes of diffusion into a systematic cartographic form favouring hegemonic narratives about the 'naturalness' of technological expansion. They connotatively reduce the perception of difference in the world and advance the case that ICTs and the Internet are a beneficent driver of economic development and social integration. As such they could be seen to be replicating colonial representation of old, a kind of neo-colonial cartography for the so-called information society, providing an authoritative view from centre and conscripting the rest of the world into economically productive digital relations.

Several of the maps analysed presented a different imaginative geography of Internet globalisation with more confused and complex narratives, in semiotic terms, about the state of the world. These maps were seen to be likely to work in favour of the 'divisionist' line of argument that sees a generally negative relationship between the Internet and the prospects of inclusive and progressive development. Three maps had overall connotative meanings of a divergent world that emphasises the large inequalities between countries at a local scale and also wide differences between regions of the world. The statistical patterns were also read as disharmonious which suggested undue complexity and the lack of systematic development process at work. The first 'International Connectivity' map from 1991 was classified as divergent in meaning between of the high degree of difference starkly evident between nations. The other two divergent maps were the three-dimensional stepped surface 'Bit Map' with its cliff-like digital divides between regions and the 'Network Society Map' that selectively targeted only nations that matter while excluding large parts of the rest of the world. The other 'divisionist' map was the dasymetric reconfiguration of the 'International Connectivity' data, produced by activist Mike Holderness, that connotatively emphasises a much complex and fragmented vision of Internet globalisation so was classified as an essentially disorderly representation.

I concluded the chapter by looking beyond the critique of cartographic imagination of Internet globalisation, considering other kinds of statistical vision that are not based on infrastructure capacity but its capacity to effect social change. This was about assessing the value of Internet infrastructure and I discussed work trying to get at a more subtle analysis of the digital divides and infrastructure diffusion, using local ethnographic studies of individual and communal use of network technologies to achieve everyday tasks and also advancing a rights based agenda. Such a 'view from the ground', so to speak, contrasts starkly with the synoptic vision offered by 'God's-eye' global statistical maps that actually hide much more than they reveal about the real state of the Internet infrastructure across the world.

7.3.2 The promotional cartographic imaginary

The second case study interrogated marketing maps produced to promote the networks of the Internet and the work they do in selling a positive geographical imagination of Internet infrastructure as reliable and trusted to potential customers and investors.

To begin it was shown how Internet network marketing maps could be situated within an established lineage of cartography used to promote commercial networks for transportation and communication. This genre of mapping practice is also interesting theoretically because the facade of 'objectivity' is negated by its serving an overt, singular commercial purpose: namely to attract prospective customers and investors from competing firms and maximise profits. Yet, for this commercially-biased mapping to work well it still seeks the cloak of objective cartographic authority in its presentation of deceptively selective data. However, the maps also silence competitors by not admitting the existence of alternative routes owned by others. This is a key differentiator of promotional cartography, that serves solely the interests of one company, from informational cartography, which serves the broader interests of consumers by mapping all available network routes.

To understand the prevalence of network maps in the marketing narratives of Internet infrastructure, a survey of the top fifty networking companies was undertaken. It revealed that over two-thirds of their corporate websites deployed network marketing maps and of these nearly thirty percent featured them prominently on the home page. Nearly all the maps denoted infrastructure using arc-node symbology on a geographic base map. Such arc-node representations are the conventional and culturally 'obvious' format for representing physical transportation infrastructures and this clearly translates meaningfully for virtual networks.

Network marketing maps work as a tangible form of proof of, firstly, the material existence of a large scale network that is beyond the limits of human vision and, secondly, the superiority of its design and engineering by showing a network that is dominant in size and fully able to span the globe. Yet, further interpretation of many of the maps showed that the network infrastructure was not world-wide at all, connecting only a small number of cities.

To consider in more depth how network marketing maps work semiotically their denotative designs were interrogated using an eight point framework of ideal connotative meanings that effective promotional cartography should produce. The framework was applied to a sample of maps from five global telecommunications corporations. Their world scale maps of their infrastructure were examined in terms of how well they were able to connote positive impressions on the range of the network links across the whole globe, the ability of the network to reach key cities, to provide direct connections to these cities, and to signal abundance coverage of continents, the network should also ideally appear to be centrally positioned to serve key markets, to offer ample capacity to meet customer demands, display their network exclusively and, lastly, to silence competitors. The analysis showed a mixed performance overall, with none of the five maps interrogated achieving all eight connotations, of an ideal network, consistently and strongly. Out of the sample, the maps of two corporations, AT&T and Verizon, performed markedly above the others. This was due partly to their simpler design and more abstract symbology that gave superior impressions of range of the network, direct connections and exclusivity. The France Telecom marketing map suffered significantly weaker connotations than its competitors, which was, in part, because it denoted the company's infrastructure too realistically and honestly. The result, in connotative terms, made the network appear to have quite limited geographic coverage of the world, unable to reach many of the important cities or to offer directness of routes necessary for rapid flows of data.

The second part of the chapter six analysed the evolving marketing of network infrastructure of one company, Worldcom through a series of maps produced over an eight year period from 1997. Again, it is evident that the maps sought to communicate persuasively and with authority, to potential customers and investors, the benefits of using Worldcom's services above those of another company by highlighting several key aspects of their infrastructure. Analysis showed the most important of these were: visually demonstrating its geographic range, the routes to reach important places and its capacity to meet customer demands. In serving these promotional goals, the semiotic analysis showed, however, Worldcom's marketing maps were only partially successful. The most significant failing in the maps was the all too obvious mismatch between the bold claims of WorldCom to offer a global network service and the mapped reality of its infrastructure that barely connected a third of countries in the world. The analysis demonstrated the real difficulties in effectively mapping Internet infrastructure of a single organisation, even for commercial persuasion.

Despite these semiotic failings, current marketing maps are enrolled in the discourses sustaining demand for new network infrastructure construction. They do critical work proving cartographically where the investors' money is going. They do this by conjuring up a sense of tangibility, a kind of second-hand experience of the network to compensate for the lack of visibility in the environment or physicality of experience. People tend to believe what they see on the map as real, particularly when it is shown using the familiar metaphors of geographic world maps.

7.4 The true vision of Internet infrastructure

A critical interpretative approach was applied to understand the ways that the Internet as a material infrastructure has been cartographically portrayed and proselytised by different interests over the last decade. As the analysis highlights, it is impossible to imagine a single 'true', objective map of the Internet. As such, there will always be a range of maps produced, for a range of purposes. I have shown how reading beyond the surface messages as intended, to interrogate the 'second text' of infrastructure can be productive for understanding the new modes of mapping that are coming into existence to chart cyberspace.

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Appendix one

Building the Atlas of Cyberspaces

at-las *n., pl.* **at-las-es**. **1.** a bound collection of maps. **2.** a bound volume of charts, plates, or tables illustrating any subject.

This appendix outlines my personal role in the developing notion of cyberspace cartographies and is focused on the contribution of my research to scholarly knowledge in relation to building and maintaining the Atlas of Cyberspaces web catalogue for ten years[1].

Figure A1.1: The front page of the Atlas of Cyberspaces web catalogue. The links on the left-hand side represent the high-level taxonomy of cyberspace cartographies presented on the site. (Source: <www.cybergeography.org/atlas>.)

[1] See <www.cybergeography.org/atlas>.

The significant part of my academic research time between 1995 and 2005 was focused on the understanding the geographies of cyberspace, what I have termed cybergeography[2]. The primary areas of concern in this research has been on analysing the spatial forms of the Internet and its supporting material infrastructures. The epistemological and philosophical approach I have taken is centred around the map as a process of knowledge construction and as social-material site for critique. The major methodological approach to achieve this has been the *Atlas of Cyberspaces* (Figure A1.1), a comprehensive web catalogue of the most significant published cyberspace maps. Examples in the Atlas are drawn from both the 'maps of cyberspace' and the 'maps for cyberspace' modes; the 'maps in cyberspace' mode is not covered. The Atlas began largely as a simple set of visual bookmarks to guide my research, but subsequently grew into a widely used and well known public resource that has helped to define the scope of cyberspace cartographies. Over the first six months of 2005, for example, it was receiving an average of eleven thousand visitors a week and according to the Google database it has 532 incoming web hyperlinks (equivalent to citations)[3].

The Atlas web catalogue remain freely available online and was continuously maintained and update for over tens years[4]. It was publicly announced in spring 1997 (via messages to various newsgroups and mailing lists; Figure A1.2) and expanded in scope as many new sections were added to index the diversity of maps and spatialization discovered. It comprises seventeen thematic sections, cataloguing 251 different cyberspace cartography examples[5]. Each item in the

[2] I began investigating this field in 1995 while a research assistant at Cardiff University and the research flourished, subsequently, at the Centre for Advanced Spatial Analysis, University College London with the support and encouragement of Professor Mike Batty.

[3] These figures exclude mirror sites and foreign language translations for which usage statistics were not obtainable.

[4] The primary URL for the site is <www.cybergeography.org/atlas>, with mirror sites provided by the Department of Geography, UCL <www.geog.ucl.ac.uk/casa/martin/atlas/atlas.html> and for the Australian / Asia-Pacific region at <http://cybergeography.planetmirror.com/>.

[5] The thematic categories are as follows: conceptual maps and diagrams, artistic representations, geographic visualisations, cables and satellites maps, traceroutes mapping tools, census maps, topology visualisations, information maps; information landscapes, information spaces, ISP maps, weather maps, wireless visualisations, web site maps, surf maps, muds and virtual worlds, historical maps. This classification mixes form and function, and reveals the evolutionary nature of the Atlas as a research tool.

Atlas contains representative visual image(s) of the map, a short descriptive text and hyperlinks to further reading/relevant Web pages. The whole resource has been translated by volunteers into French, Italian, Spanish and Portuguese[6]. In 2001 a 270-page long 'coffee-table' book version of the Atlas was published, co-authored with Rob Kitchin; whilst it drew heavily from the Web Atlas, it had many fewer examples and a simplified taxonomy.

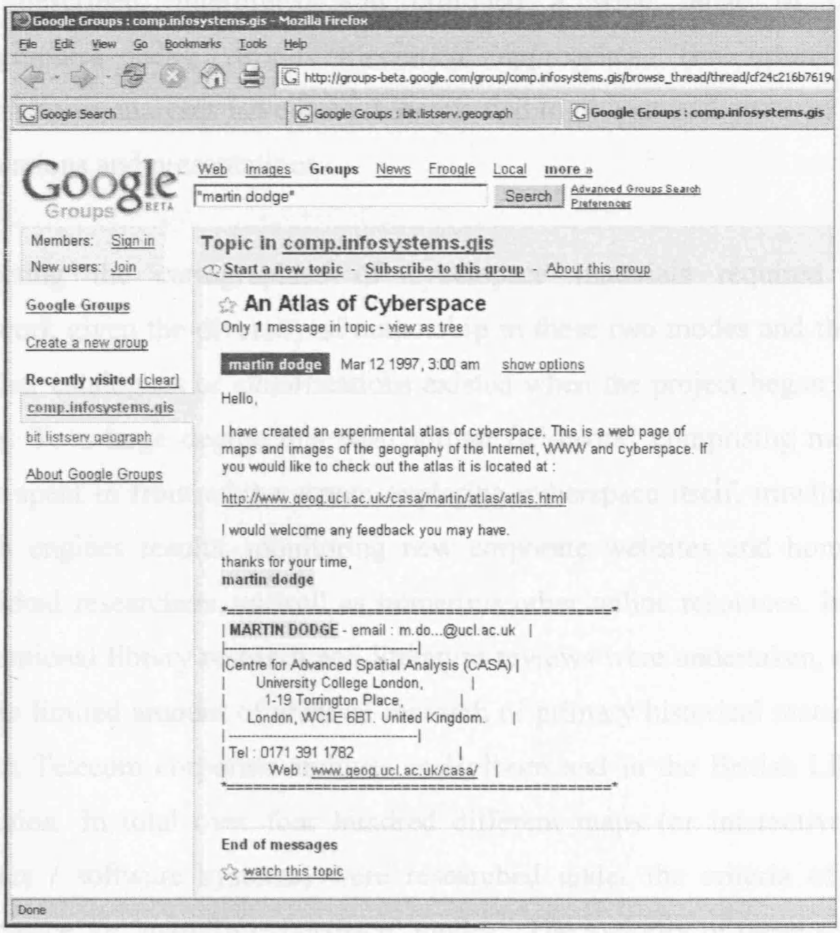

Figure A1.2: Original public announcement of the *Atlas of Cyberspaces* web catalogue, posted to the comp.infosystems.gis newsgroup in March 1997. (Source: <www.google.com/groups>.)

[6] The French language mirror site was maintained by Nicolas Guillard, <www.cybergeography-fr.org/atlas/atlas.html>.
Italian language mirror was initially created by Paolo Cavallotti and then maintained by Giuliano Gaia and Stefania Bojano, <www.mappedellarete.net/>.
Rodrigo Nóbrega maintained the Portuguese language mirror site, <http://cibergeografia.org/atlas/atlas.html>.
Emiliano Rodriguez Nüesch translated the Spanish language version, <www.cybergeography.org/spanish/atlas.html>.

My contribution to the analysis of cyberspace cartographies through the Atlas web catalogue has been primarily as a curator, surveying the diversity of examples, classifying and interpreting them and then assembling a selection into a structured typology for public display. The resulting Atlas presentation was the most comprehensive one produced by 2002 and has significantly greater value as a curated whole than the simply the sum of its parts (given as an unedited bibliography or set of bookmarks). As well as curating the Atlas on the web, I have described, interpreted and critiqued a wide range of cyberspace cartographies using various theoretical approaches. The results of these interpretative analyses have been disseminated to diverse audiences in a range of publications and presentations.

Collecting the cartographies of cyberspace materials required extensive fieldwork given the diversity of authorship in these two modes and the fact that no other catalogues or classifications existed when the project began in the mid 1990s. To a large degree this was 'virtual fieldwork' comprising many, many hours spent in front of the screen exploring cyberspace itself, trawling through search engines results, monitoring new corporate websites and homepages of individual researchers, as well as numerous other online resources. In addition, conventional library research and literature reviews were undertaken, along with a more limited amount of archival research of primary historical materials at the British Telecom corporate archives in Holborn and in the British Library map collection. In total over four hundred different maps (or interactive mapping projects / software systems) were researched under the criteria of 'maps <u>of</u> cyberspace' or 'map <u>for</u> cyberspace' modes[7]. The majority of these are archived and not displayed in the Atlas. Besides archiving copies of the cyberspace maps themselves, relevant supporting papers, descriptive Web pages, and biographic details on the creators were also kept. As part of the fieldwork process I also built a significant professional knowledge network, making personal contact with

[7] I have been limited to collecting *published* maps, i.e. those that are available in the public domain. It is certain that there are many more maps of cyberspace created by individuals, corporations and governments never released into the public domain, either because of reasons of confidentially and security, lack of resources or interest, or a belief that the maps are too technical and will, therefore, be of no practical use to the wider public. In addition, my researches have been largely restricted to English-language materials.

many of the map-makers and other interested parties through email, mailing list discussions and individual interviews. Twenty-two map-makers were interviewed via email by myself between 1999 - 2003 and the findings written up and published as 'map of the month' articles[8]. In totality, this collection of materials arising from the fieldwork represents a valuable contribution to the history of cartography.

As an information resource, the Atlas has had an impact within human geography discourses, for example it was highlighted by AAG president Duane Nellis in the *AAG Newsletter* (November 2002, 3) as a prime example of innovative new research which "documents the worldwide infosphere fostered by the internet that will surely be of growing importance as the millennials further transform the ways we interact within geography". While cartography theorist John Pickles (2004a, 194) in his book 'A History of Spaces' cites the Atlas in the conclusion arguing that it reveals the "conceptual flexibilities and political possibilities" of new cartographies that have "de-ontologized whatever we ever meant by modern cartography in ways that we are perhaps only beginning to recognize." Further, Pickles (2004b, 184) notes the Atlas "is rich and varied, and the maps illustrate well the geographically uneven nature of access, connectivity and interaction in this new 'world in the wires'". More importantly, the website has proven to be a productive medium to disseminate my research beyond the confines of geography, becoming visible in many other disciplines and outside academia. The website is also used as a teaching resource for many courses, across disciplines. The Atlas has also been cited frequently in the press (e.g., The New York Times, see chapter three, Figure 3.8). Lastly, it has acted as a catalyst in informing different groups about each others work, cross linking ideas and maps between information science, media studies, network engineering, artists, and designer, as well geography/cartography of course.

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[8] These majority of these articles were published in *Mappa.Mundi Magazine* and usually involved a detailed examination of a specific example map that best represents a particular genre of cyberspace cartography, and, where possible, an interview with the mapmaker to determine their aims and intentions. All the articles are accessible from <www.cybergeography.org/>.

In addition to the Web catalogue, I have actively disseminated ideas about cyberspace cartographies to a diverse range of audiences through invitations to give talks at conferences, in departmental seminar series and to industry. For example, in 2001 I spoke in the Department of Architecture, Princeton University; in April 2000 I participated in a symposium at the Department of Design and Media Arts, UCLA; and more recently at the end of 2004 I gave a keynote presentation for a workshop on 'e-social science' at the School of Social Sciences at the Australian National University and an invited talk the Ordnance Survey in Southampton. Key published output also included two books, both co-authored with Rob Kitchin. These have been well received and cited; the first, Mapping Cyberspace (Routledge, 2000), currently has 81 citations according to ISI Web of Science. I have also written a number of other articles and book chapters considering different aspects of cyberspace cartographies, in which I have tried to meld together a technical understanding of their formal properties with some consideration of their wider social implications and cultural meanings (see Dodge 1998, 2000a, 2000b, 2002; Dodge and Kitchin 2000b). I have also fostered a network of researchers, scholars and practitioners from across the world and across multiple disciplines interested in cyberspace cartographies by publishing a regular email bulletin[9] and as the moderator of the mapping-cyberspace listserv[10].

In conclusion, the Atlas of Cyberspaces web catalogue acted as one of the key international knowledge hubs for cyberspace cartographies and virtual geographies. My researches as a whole have helped to define cyberspace cartographies as a coherent and legitimate field of academic enquiry.

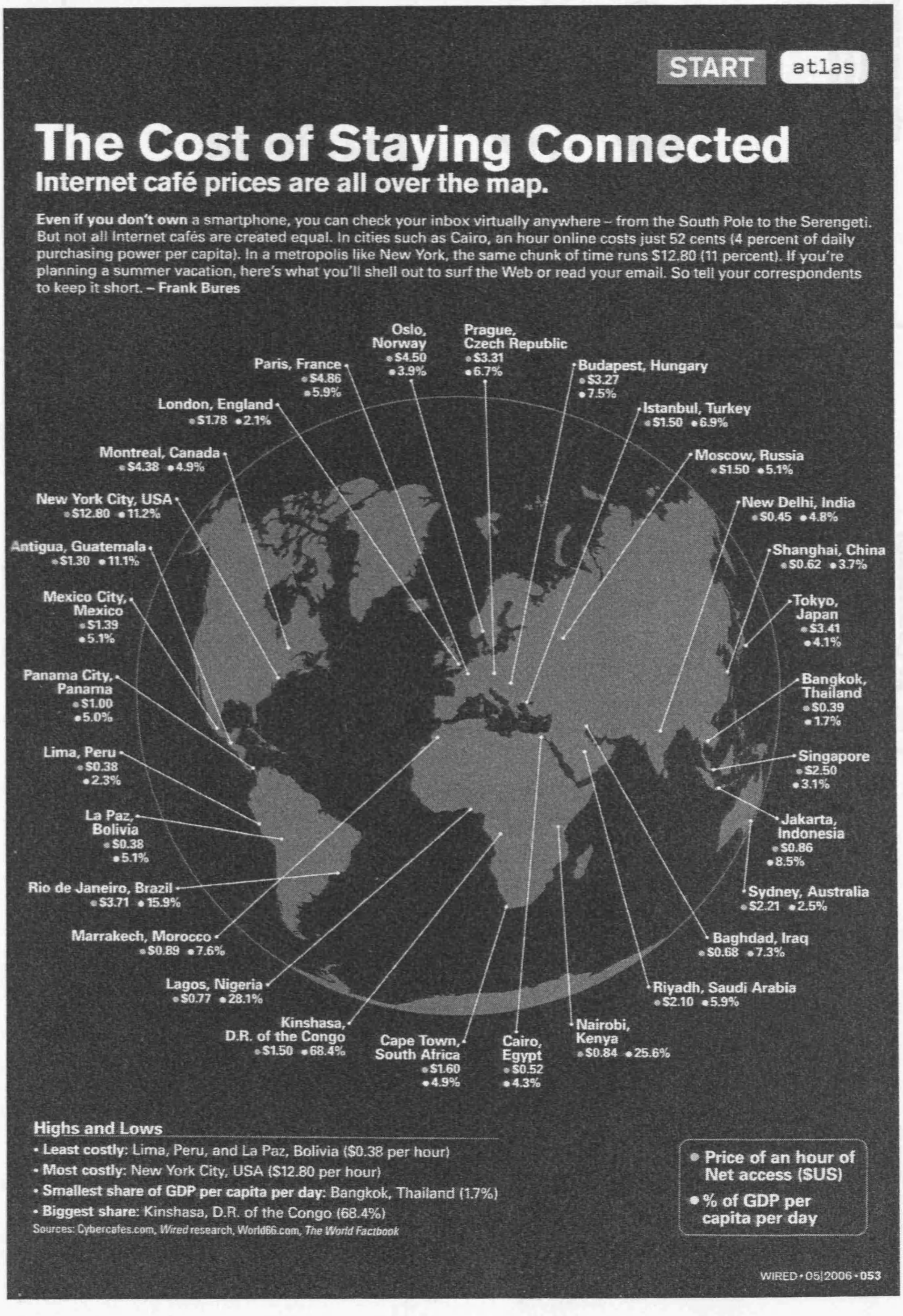
[9] Located at <www.cybergeography.org/register.html>. It has been running since June 1997 to February 2004 and had 6,100 subscribers by the end.

[10] Located at <www.cybergeography.org/discussion.html>. It currently has over 500 subscribers.

Appendix Two

Statistical Maps of Internet Globalisation

Figure A2.1: The cost of staying connected, published in Wired magazine 2006. (Source: scanned version from <www.flickr.com/photos/24657869@N00/156209557>.)



START atlas

The Cost of Staying Connected

Internet café prices are all over the map.

Even if you don't own a smartphone, you can check your inbox virtually anywhere – from the South Pole to the Serengeti. But not all Internet cafés are created equal. In cities such as Cairo, an hour online costs just 52 cents (4 percent of daily purchasing power per capita). In a metropolis like New York, the same chunk of time runs $12.80 (11 percent). If you're planning a summer vacation, here's what you'll shell out to surf the Web or read your email. So tell your correspondents to keep it short. – **Frank Bures**

Highs and Lows

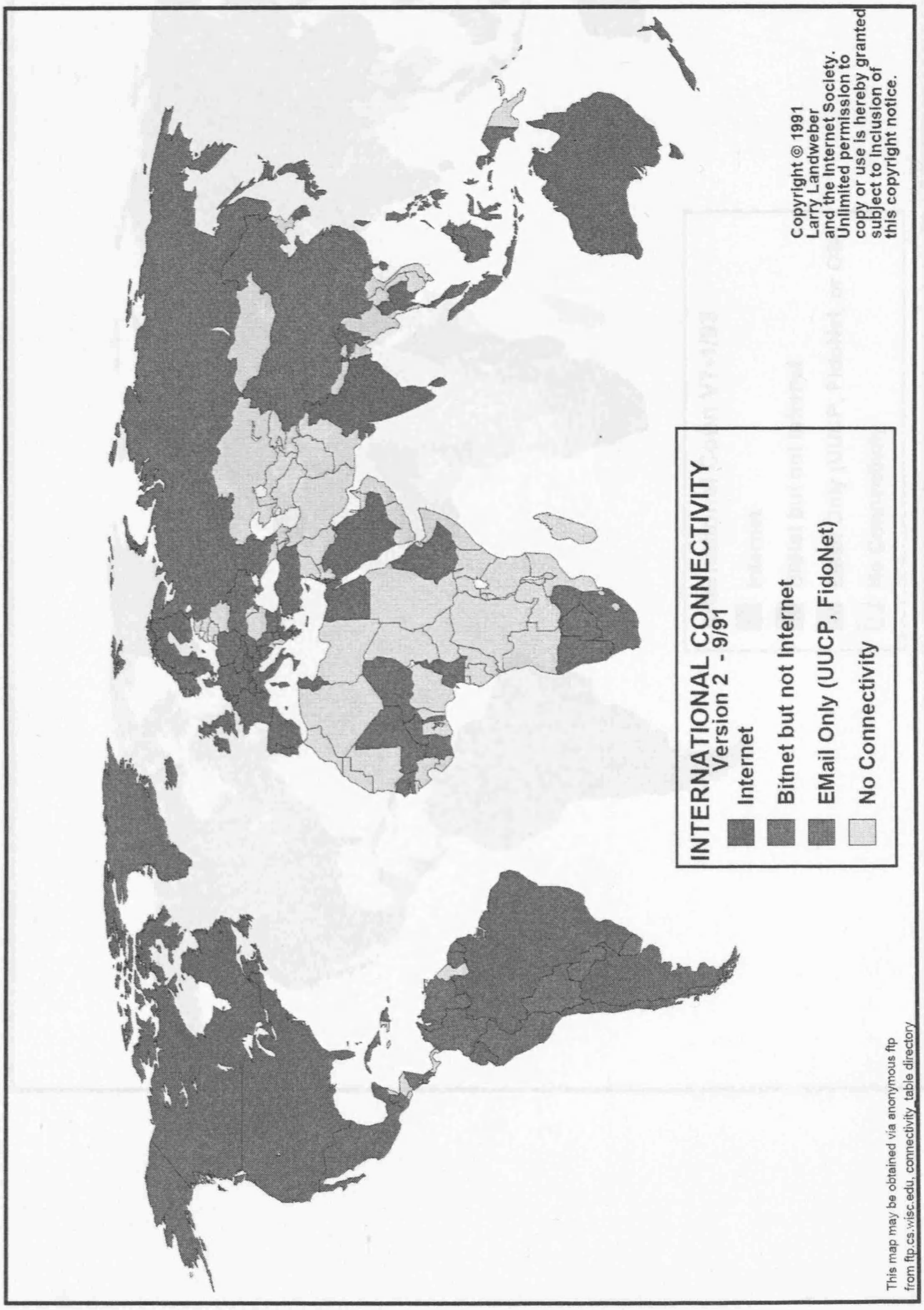
- **Least costly:** Lima, Peru, and La Paz, Bolivia ($0.38 per hour)
- **Most costly:** New York City, USA ($12.80 per hour)
- **Smallest share of GDP per capita per day:** Bangkok, Thailand (1.7%)
- **Biggest share:** Kinshasa, D.R. of the Congo (68.4%)

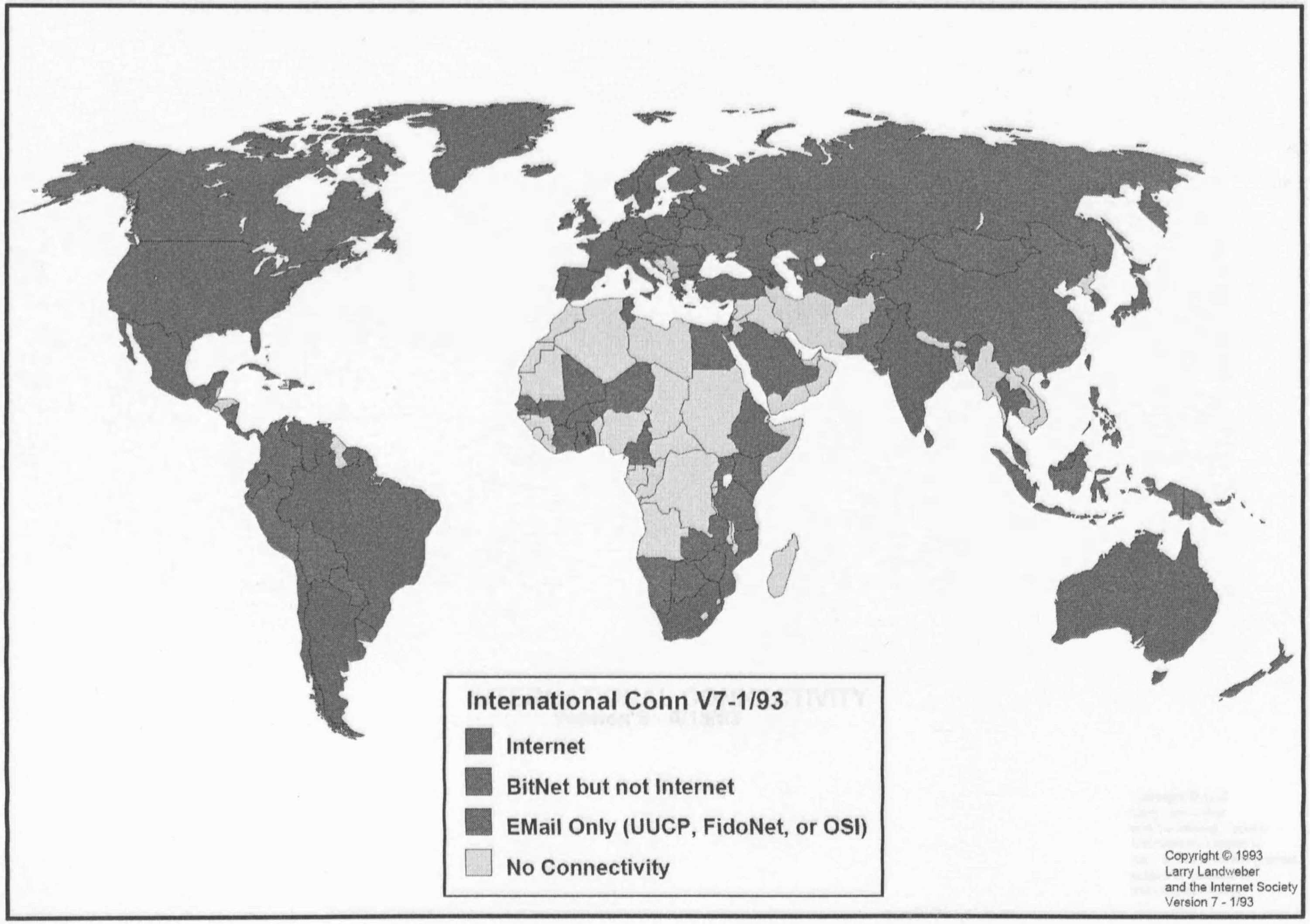
Sources: Cybercafes.com, *Wired* research, World66.com, *The World Factbook*

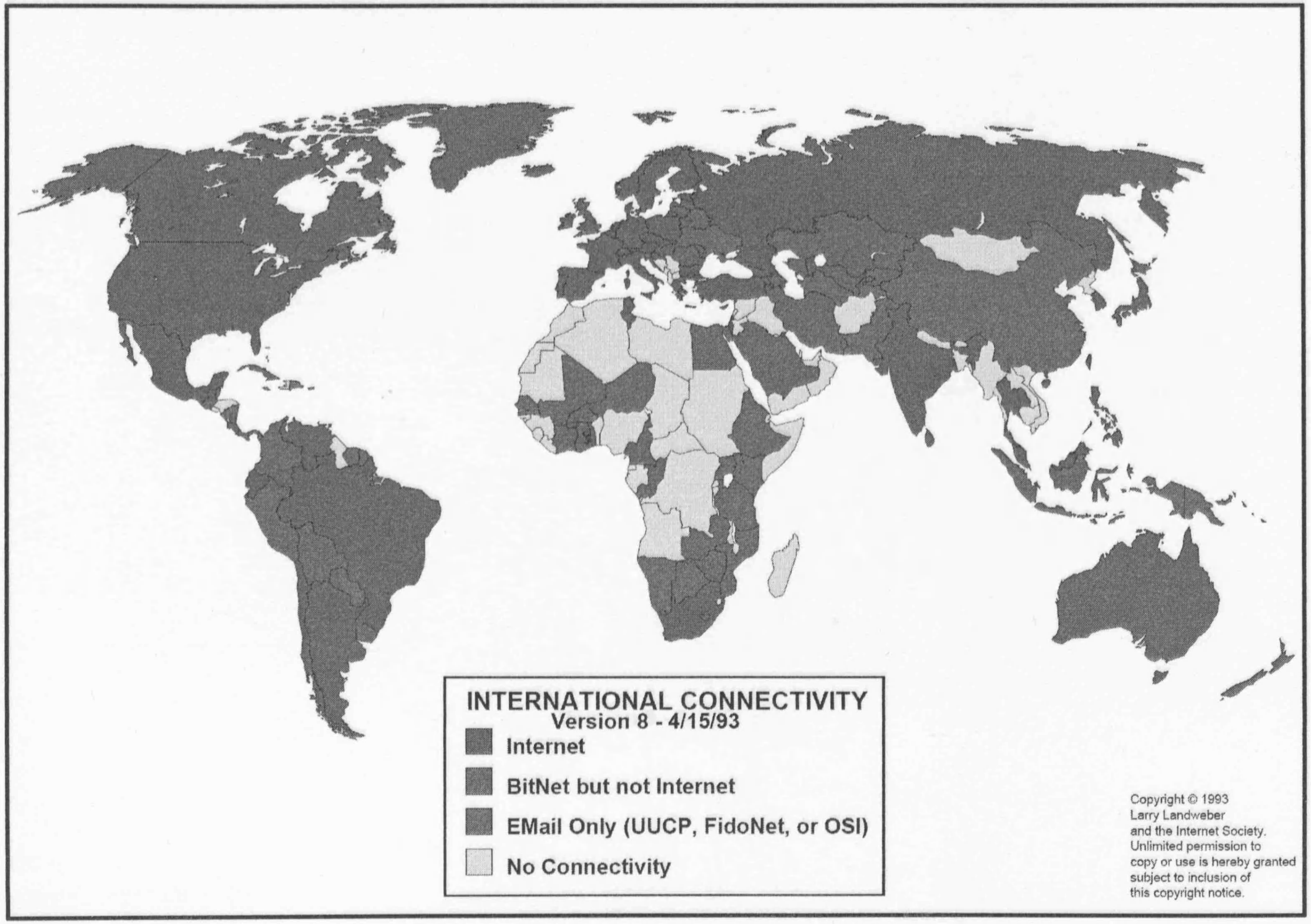
- Price of an hour of Net access ($US)
- % of GDP per capita per day

WIRED • 05|2006 • 053

Figure A2.2: Sequence of 11 International Connectivity maps from 1991-1997 produced by Lawrence Landweber. (Source: <ftp.cs.wisc.edu/connectivity_table/>.)




International Conn V7-1/93
Internet
BitNet but not Internet
EMail Only (UUCP, FidoNet, or OSI)
No Connectivity
Copyright © 1993
Larry Landweber
and the Internet Society
Version 7 - 1/93


INTERNATIONAL CONNECTIVITY
Version 8 - 4/15/93
Internet
BitNet but not Internet
EMail Only (UUCP, FidoNet, or OSI)
No Connectivity
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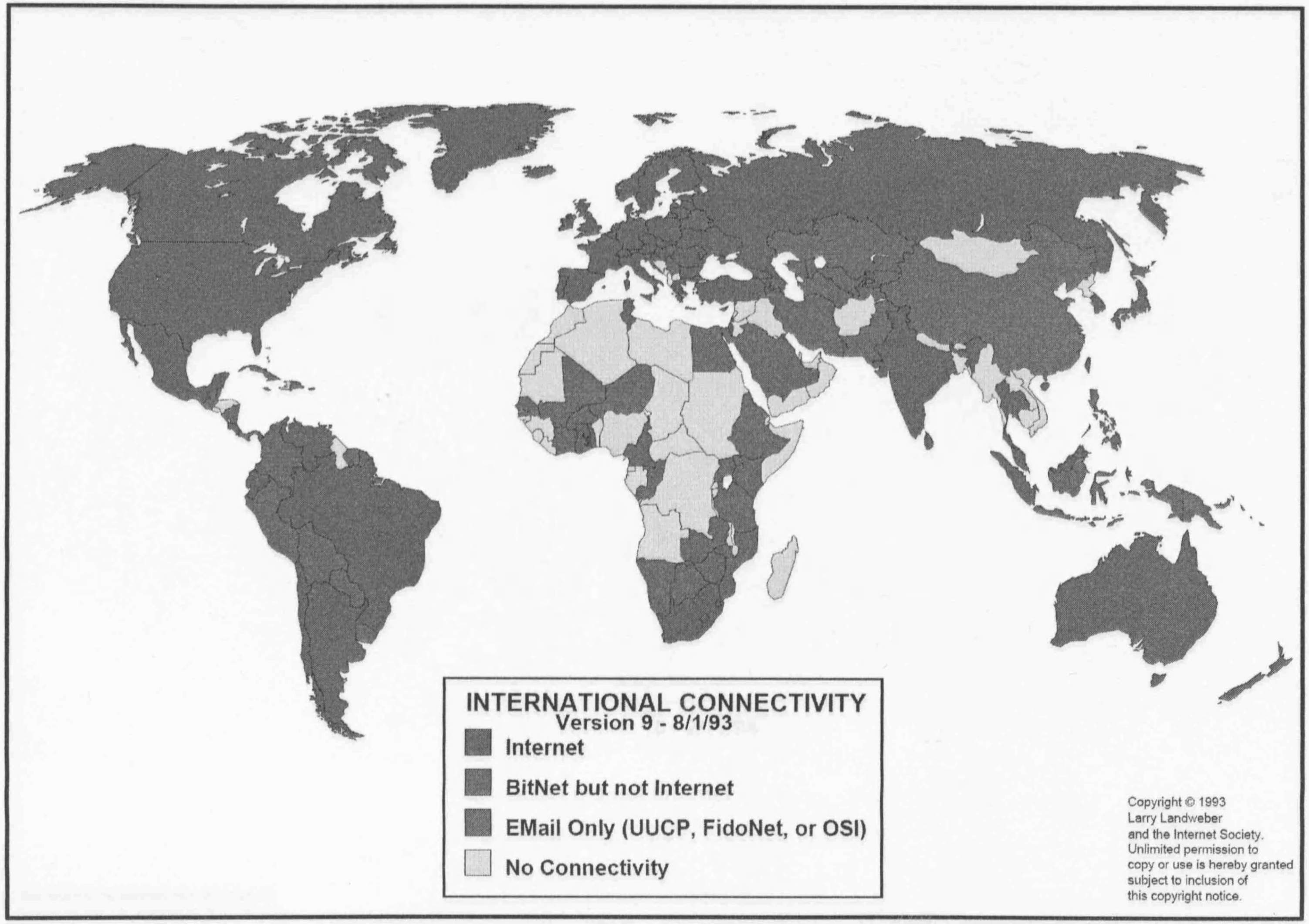
INTERNATIONAL CONNECTIVITY
Version 9 - 8/1/93
Internet
BitNet but not Internet
EMail Only (UUCP, FidoNet, or OSI)
No Connectivity
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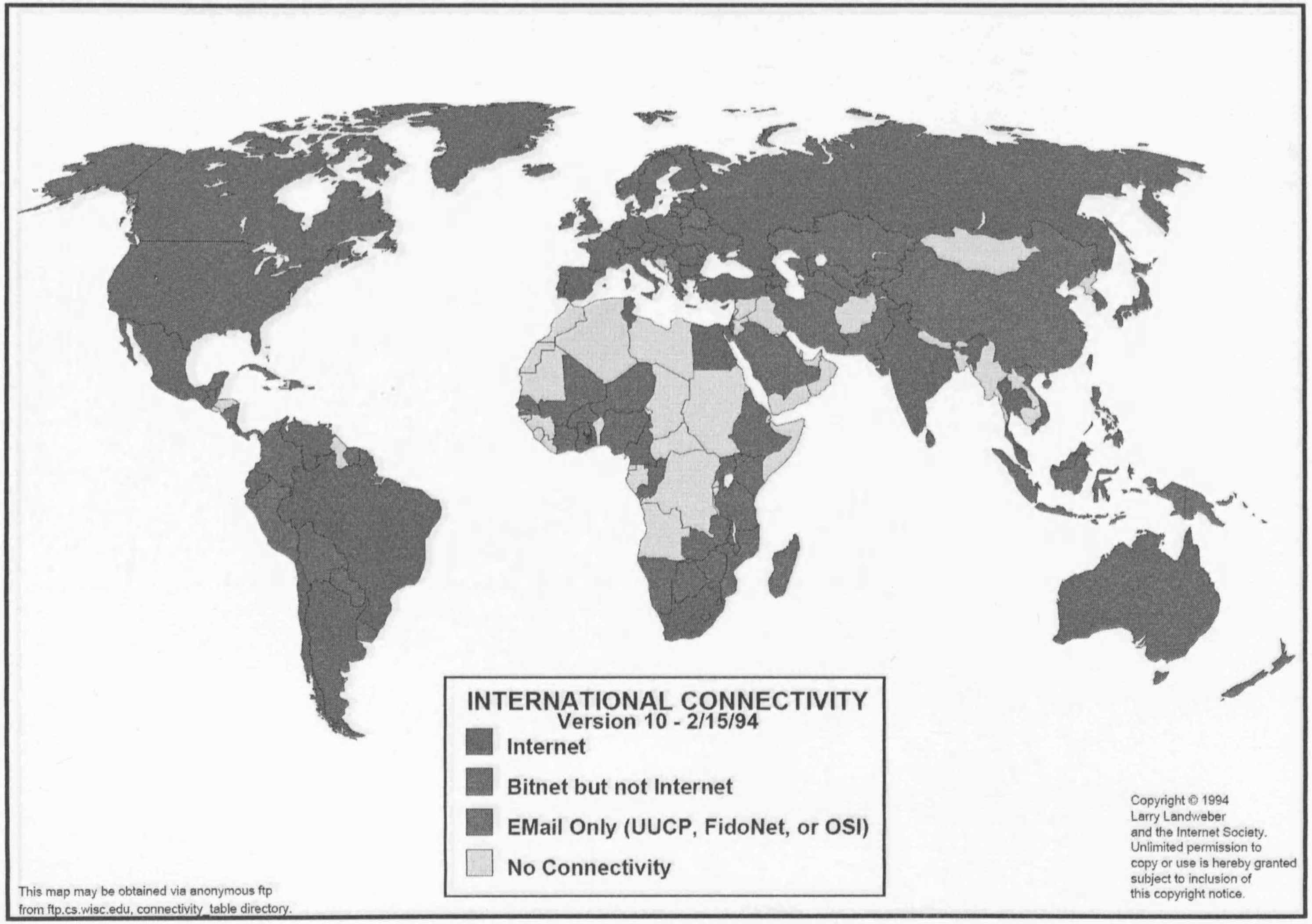
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Version 10 - 2/15/94
Internet
Bitnet but not Internet
EMail Only (UUCP, FidoNet, or OSI)
No Connectivity
This map may be obtained via anonymous ftp
from ftp.cs.wisc.edu, connectivity_table directory.
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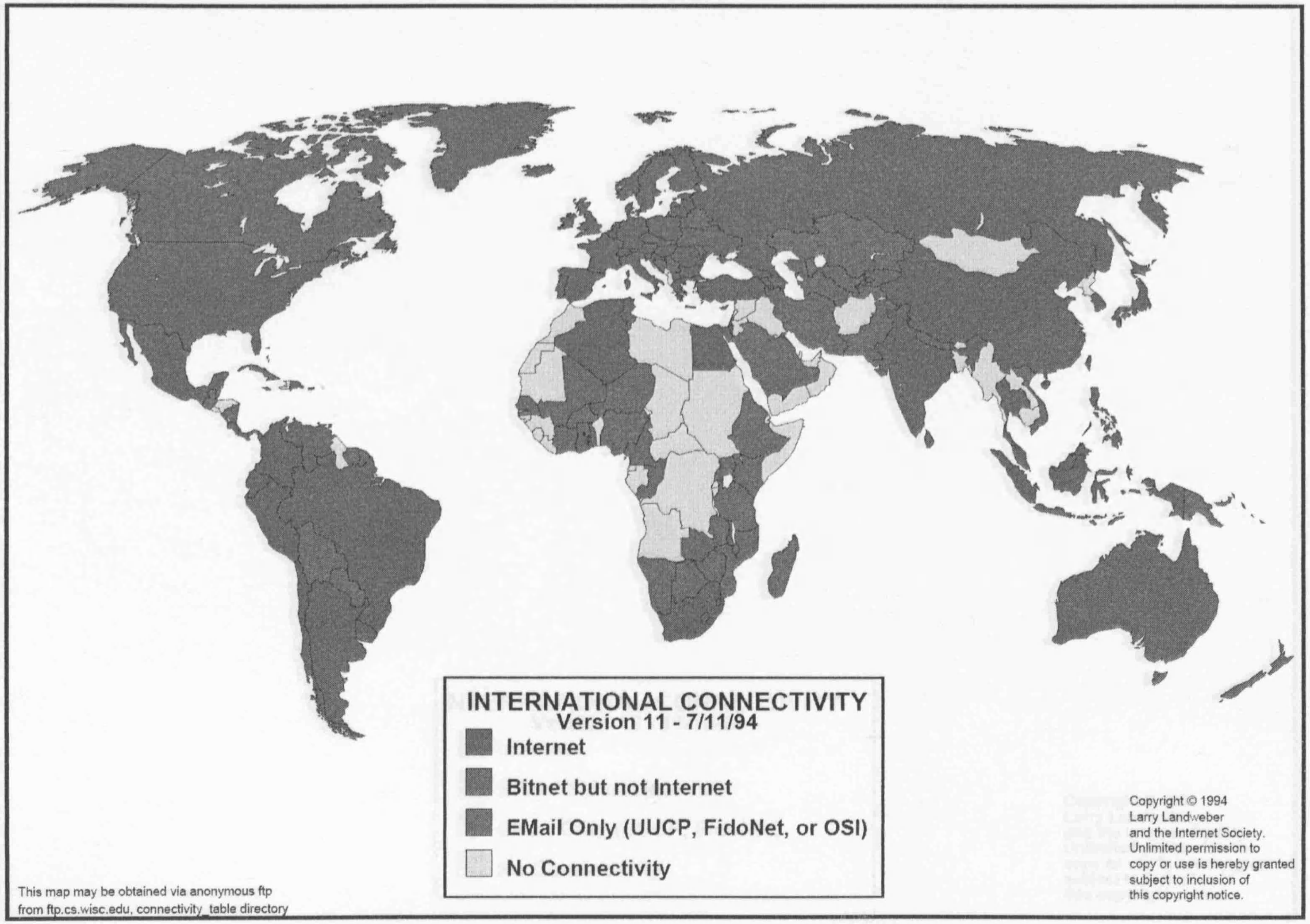
INTERNATIONAL CONNECTIVITY
Version 11 - 7/11/94
Internet
Bitnet but not Internet
EMail Only (UUCP, FidoNet, or OSI)
No Connectivity
This map may be obtained via anonymous ftp
from ftp.cs.wisc.edu, connectivity_table directory
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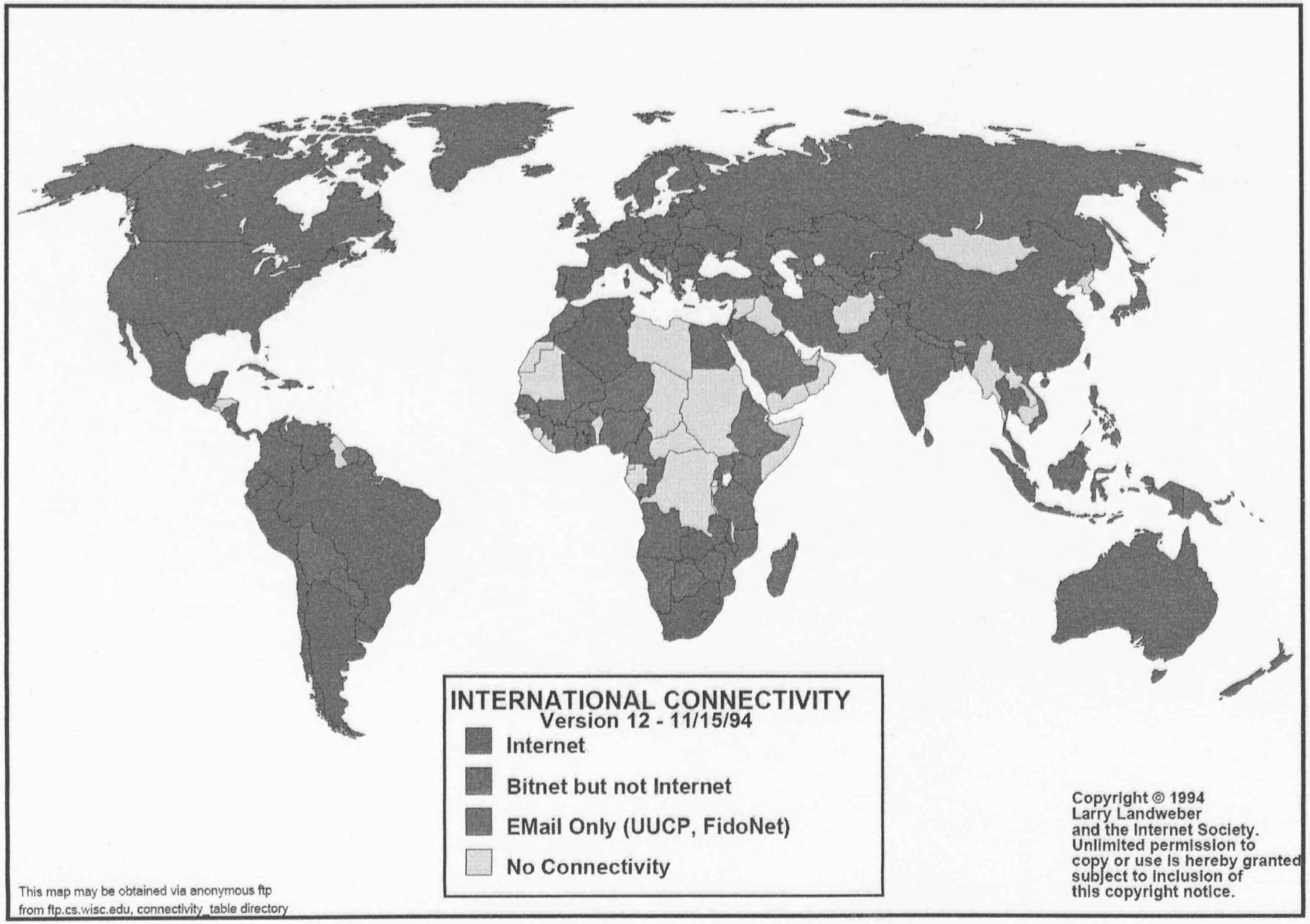
INTERNATIONAL CONNECTIVITY
Version 12 - 11/15/94
Internet
Bitnet but not Internet
EMail Only (UUCP, FidoNet)
No Connectivity
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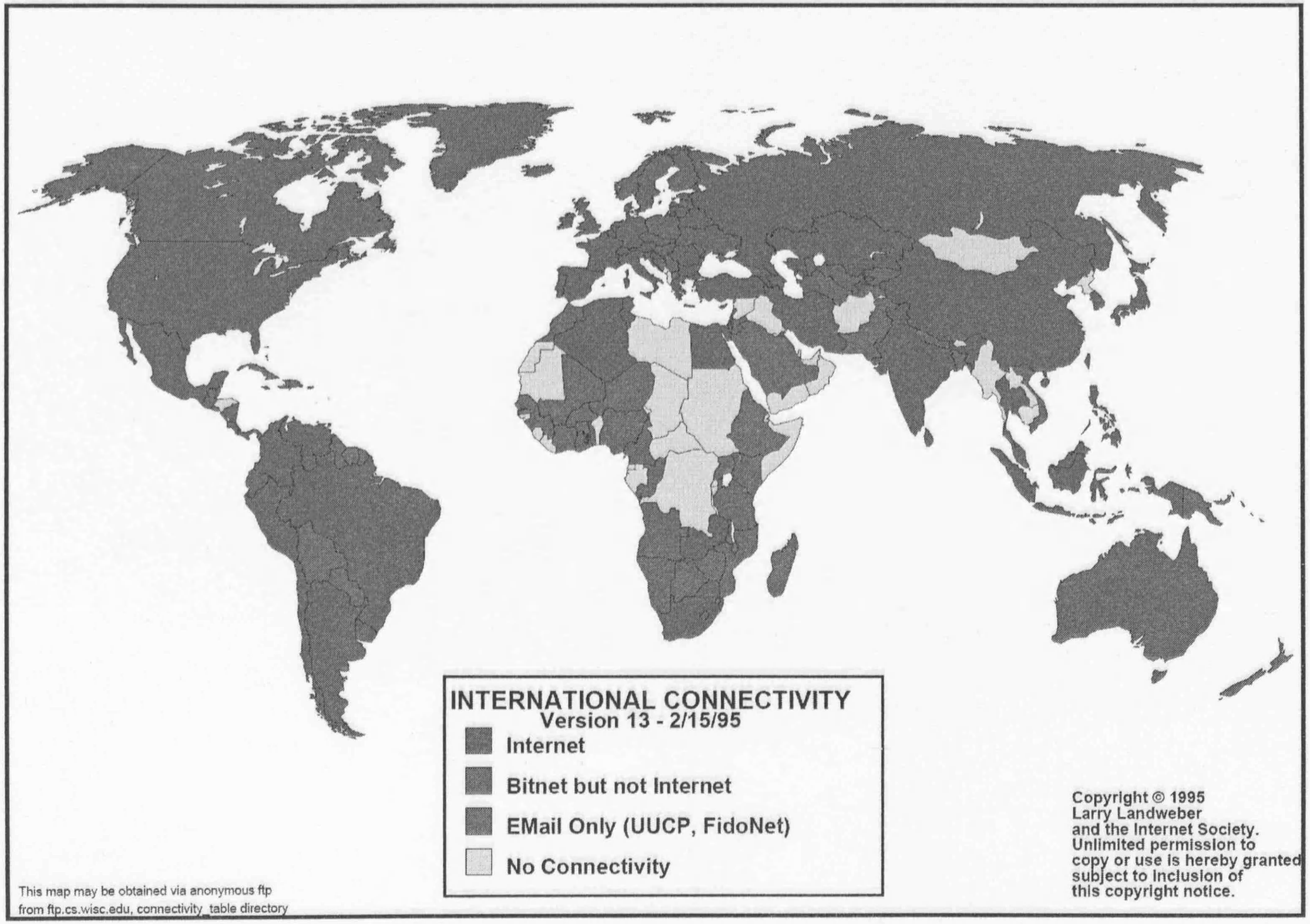
from ftp.cs.wisc.edu, connectivity_table directory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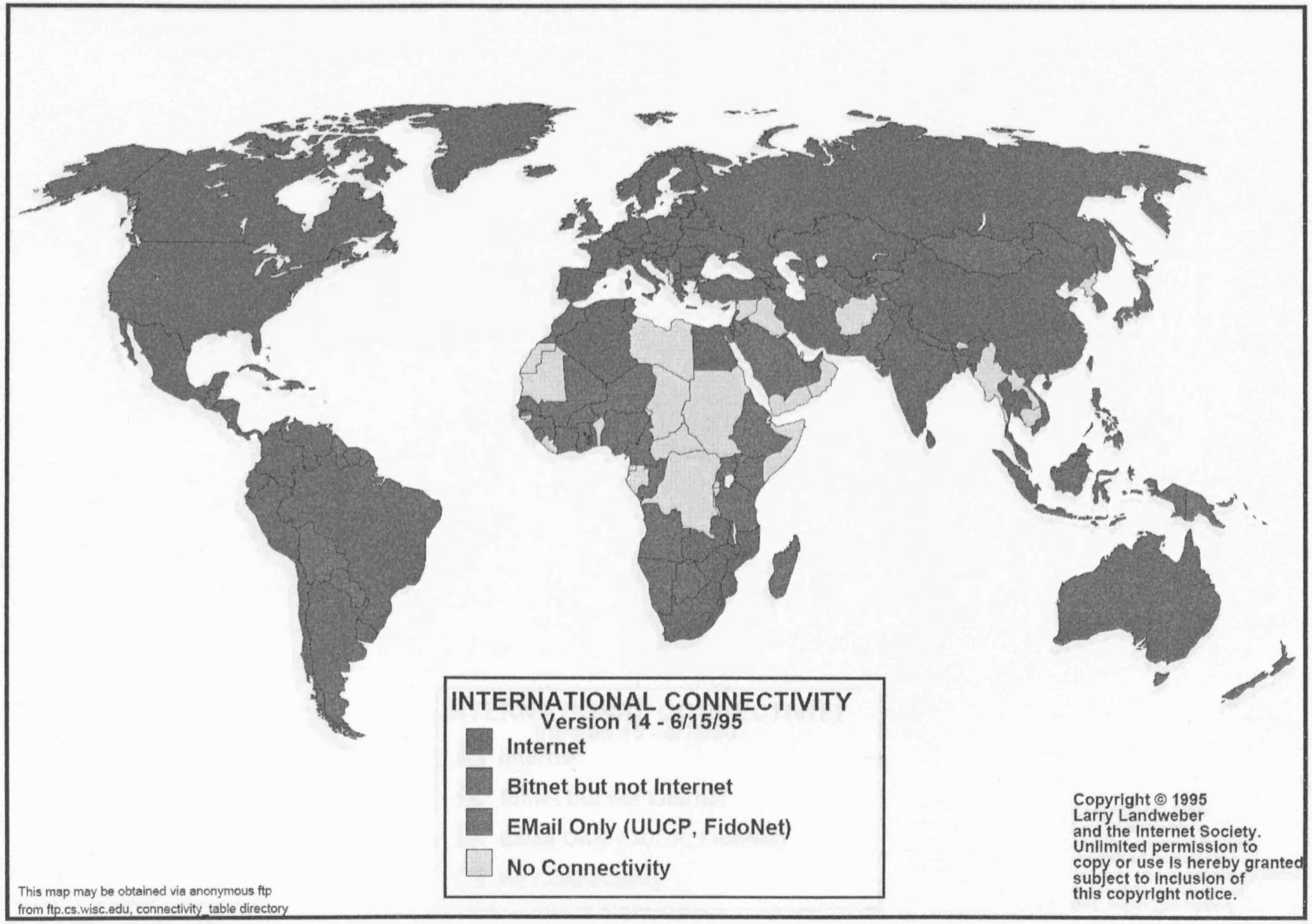
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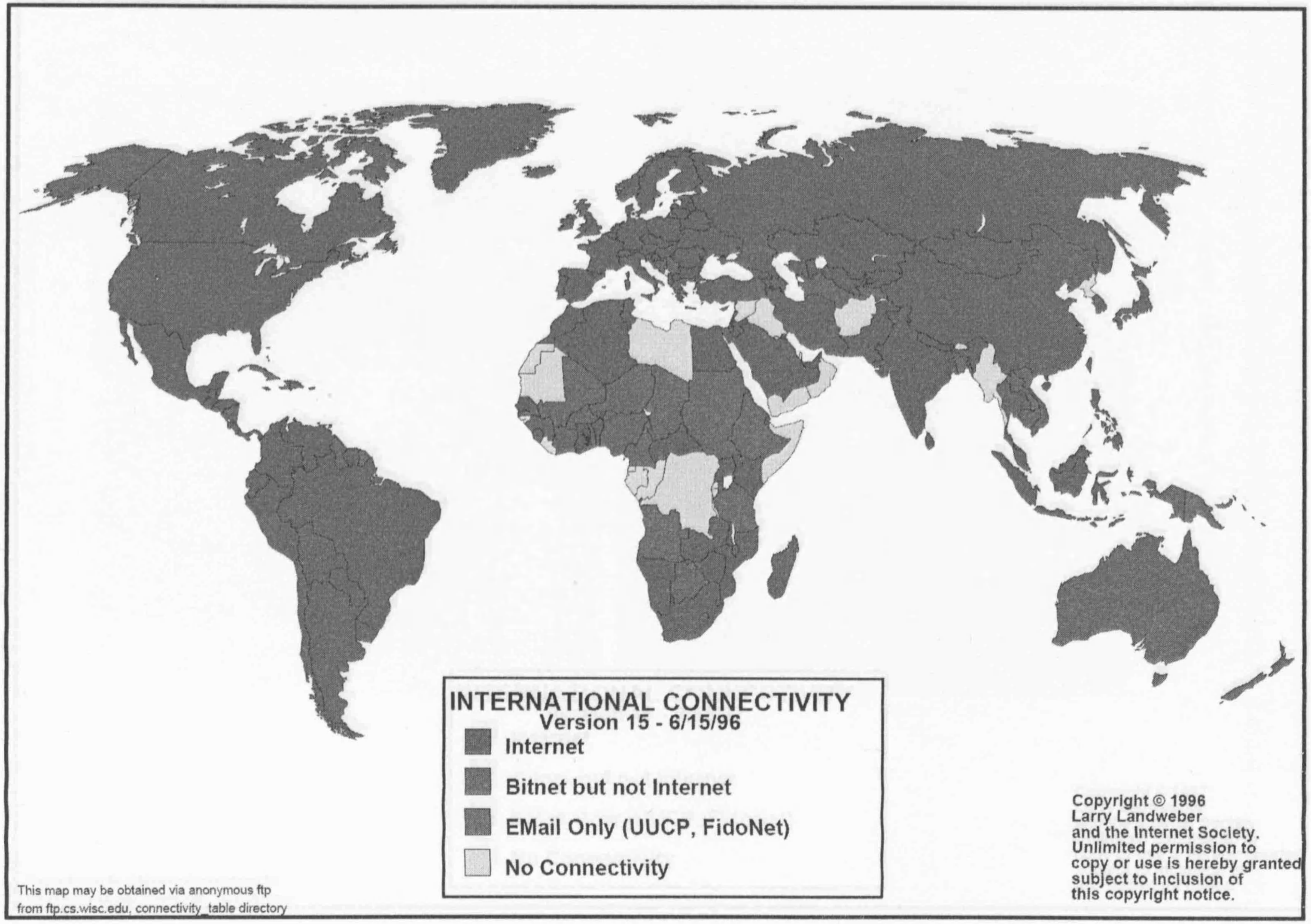
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Version 15 - 6/15/96
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EMail Only (UUCP, FidoNet)
No Connectivity
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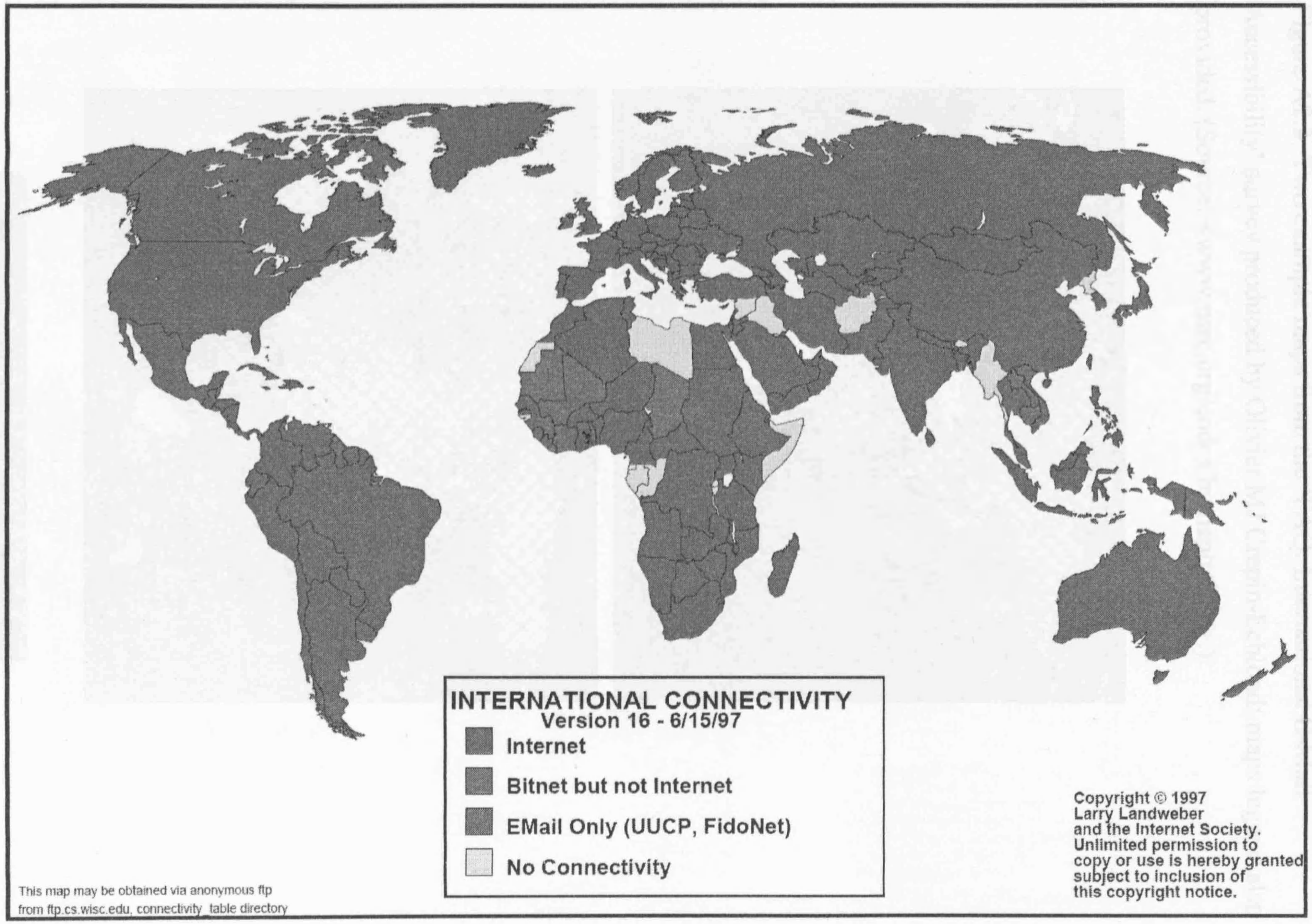
INTERNATIONAL CONNECTIVITY
Version 16 - 6/15/97
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Bitnet but not Internet
EMail Only (UUCP, FidoNet)
No Connectivity
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Figure A2.3: Two example maps from the 'FAQ: International E-Mail Accessibility' survey produced by Olivier MJ Crepin-Leblond; maps legend also provided. (Source: <www.nsrc.org/codes/bymap/ntlgy/>.)

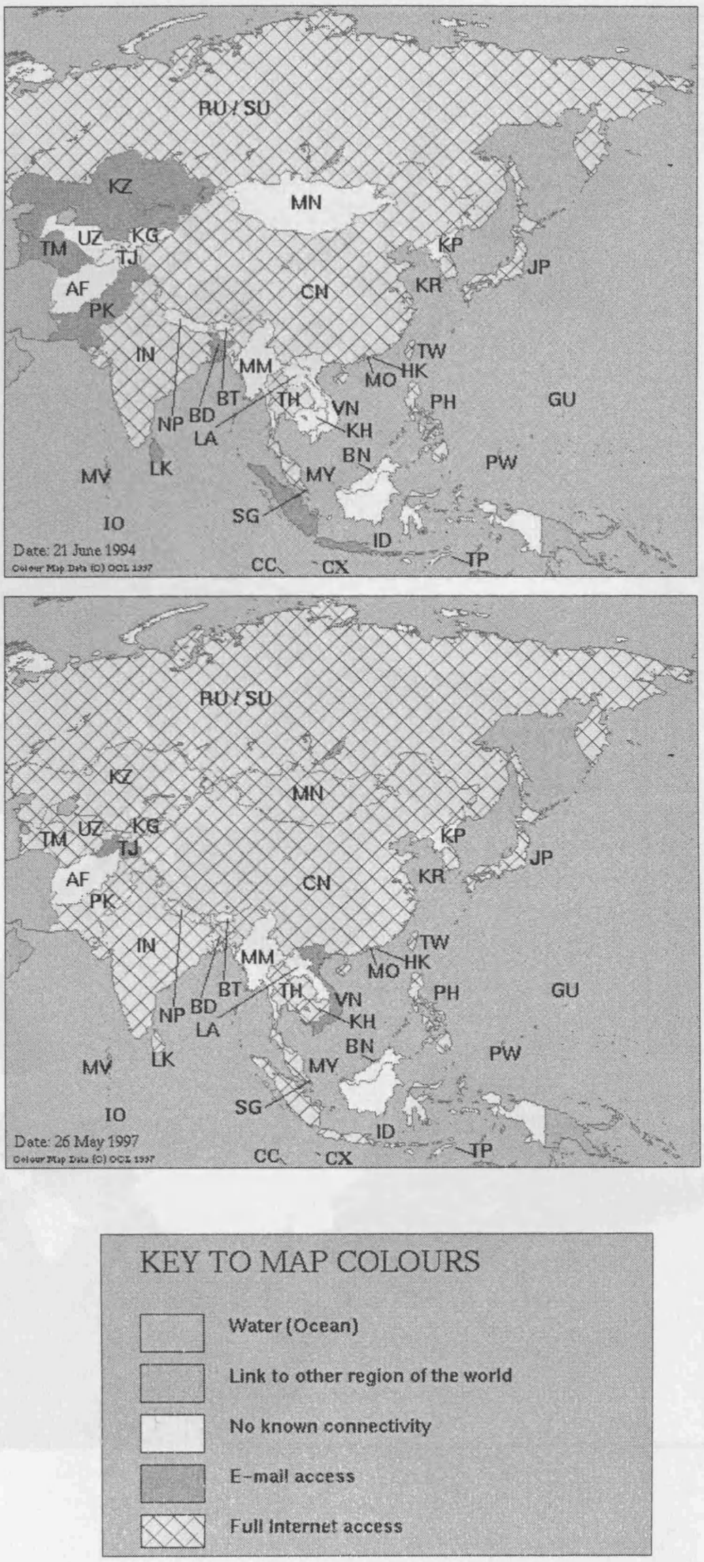

Figure A2.4: Updated version of the 1997 International Connectivity map produced by Mike Jensen. (Source: <www3.wn.apc.org/africa/afstat.htm>, no longer available online.)

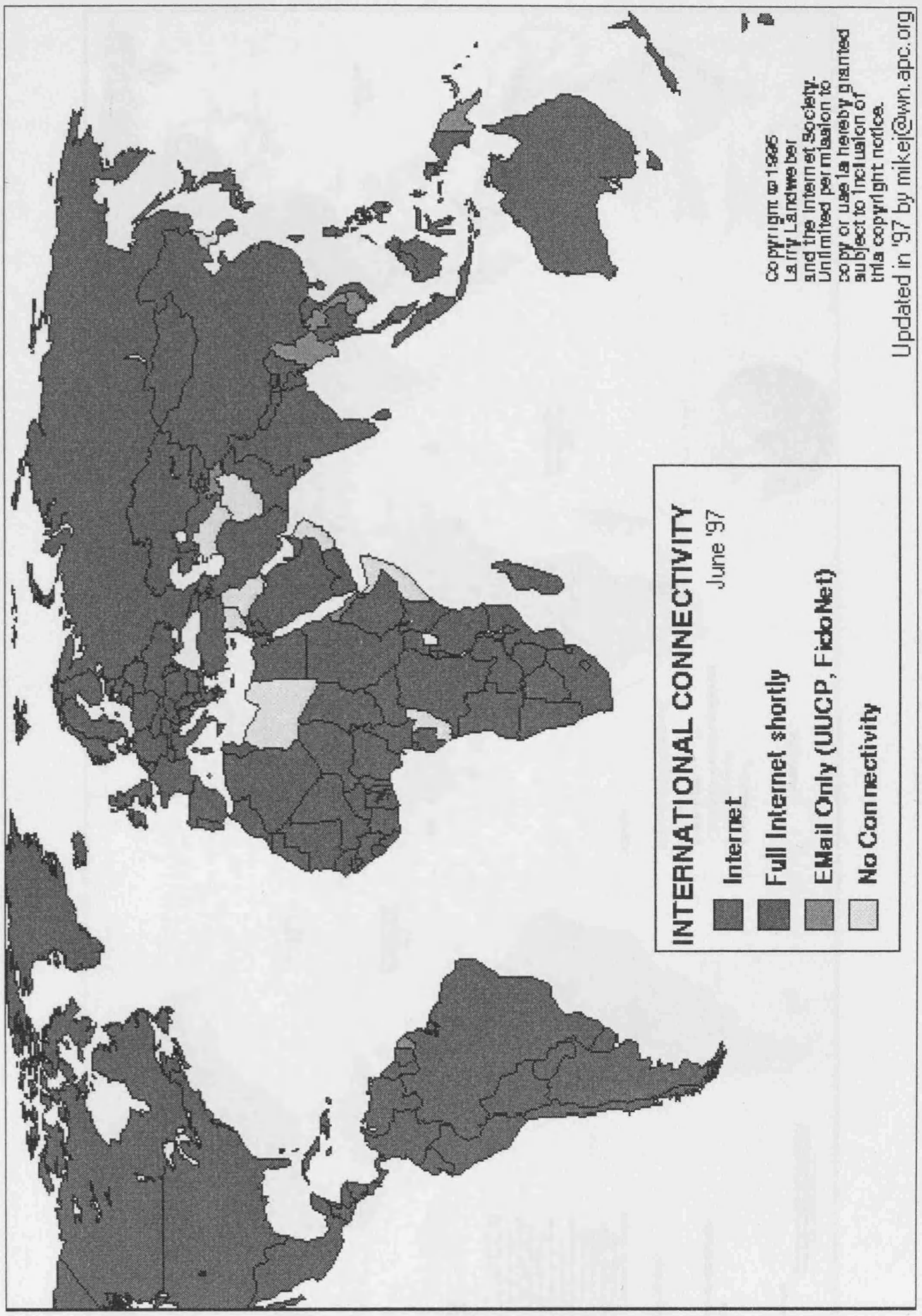

Figure A2.5: The 'Pentagon's New Map', published by Esquire magazine to illustrate a story about Thomas Barnett's work, March 2003 (Source: <www.thomaspmbarnett.com/images/books/pentagons_new_map_small.jpg>.)

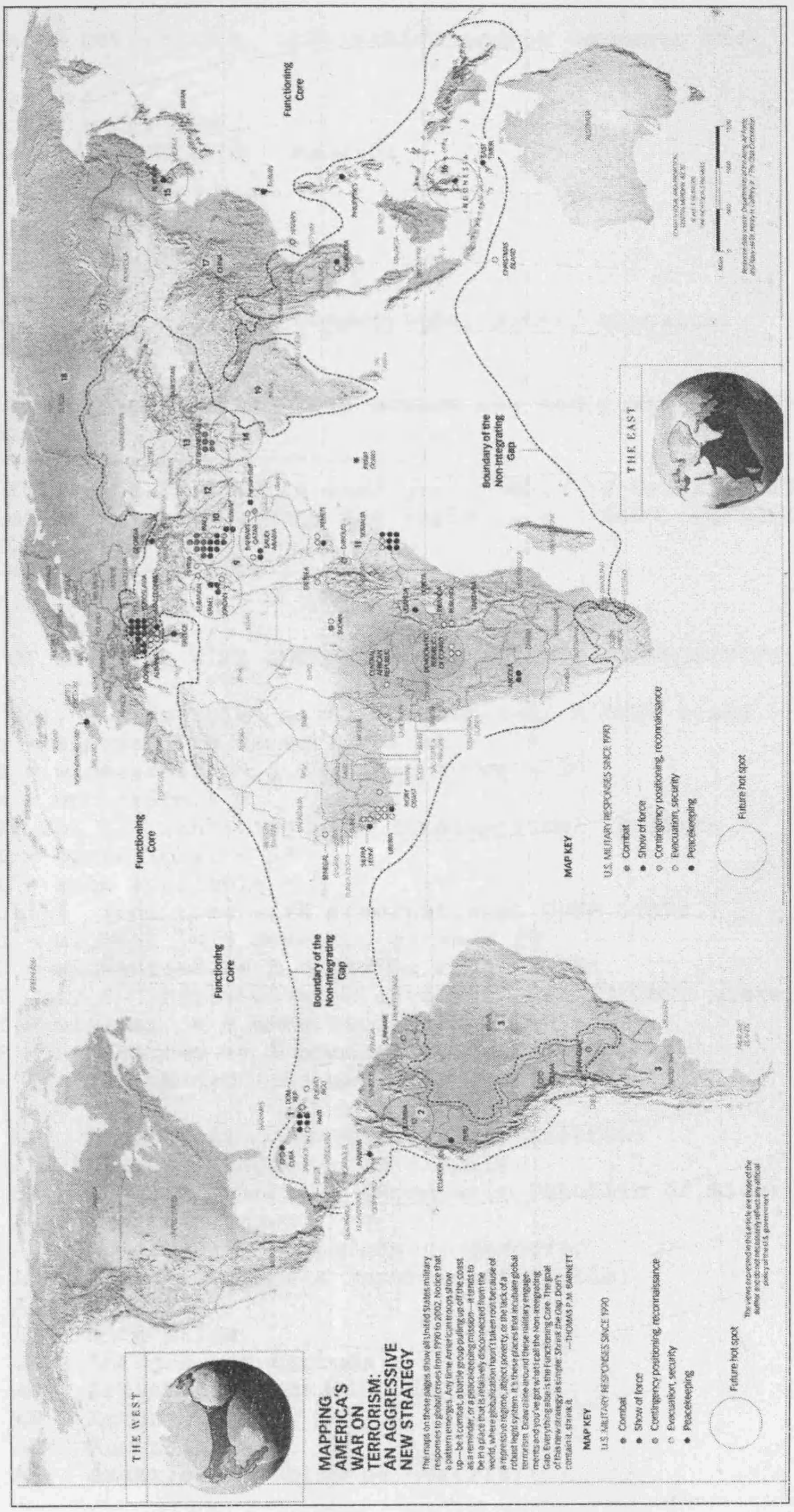

Figure A2.6: Data table of the International Connectivity survey, December 1991. (Source: <ftp.cs.wisc.edu/connectivity_table/>.)

```
NTERNATIONAL CONNECTIVITY
Version 3 - December 2, 1991

Please send corrections, information and/or comments to:

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1210 W. Dayton St.
Madison, WI 53706
lhl@cs.wisc.edu
FAX 1-608-265-2635

Include details, e.g., on connections, sites, contacts,
protocols, etc.

Thanks to the many people from around the world who have provided
information.
-----------------------------------
In the following, BITNET is used generically to refer to BITNET
plus similar networks around the world (e.g., EARN, NETNORTH,
GULFNET, etc.).
---------------------------------
SUMMARY

NUMBER OF ENTITIES WITH INTERNATIONAL NETWORK CONNECTIVITY = 89

BITNET Col. 2  (Entities with international BITNET links.)
      b = minimal < 5 domestic sites =  18
      B = widespread >= 5 domestic sites = 28
      x = uncertain = 2
INTERNET Col. 3  (Entities with international IP links.)
      I = operational = 33
      i = soon available = 3
UUCP Col. 4  (Entities with international UUCP links.)
      u = minimal  < 5 domestic sites = 40
      U = widespread >= 5 domestic sites = 38
FIDONET Col. 5  (Entities with international FIDONET links.)
      f = minimal  < 5 domestic sites =  10
      F = widespread >= 5 domestic sites =  43
Col 6 = * = New connections expected in near future.

 ----  AF   Afghanistan (Republic of Afghanistan)
 ----  AL   Albania (Republic of Albania)
 ----  DZ   Algeria (People's Democratic Republic of Algeria)
 ----  AS   American Samoa
 ----  AD   Andorra (Principality of Andorra)
 ----  AO   Angola (People's Republic of Angola)
 ----  AI   Anguilla
 ----* AQ   Antarctica
 ----  AG   Antigua and Barbuda
 BIUF  AR   Argentina (Argentine Republic)
 ----  AW   Aruba
 -IUF  AU   Australia
 BIUF  AT   Austria (Republic of Austria)
```

----	BS	Bahamas (Commonwealth of the Bahamas)
----	BH	Bahrain (State of Bahrain)
----	BD	Bangladesh (People's Republic of Bangladesh)
----	BB	Barbados
BIUF	BE	Belgium (Kingdom of Belgium)
----	BZ	Belize
----	BJ	Benin (Republic of Benin)
----	BM	Bermuda
----	BT	Bhutan (Kingdom of Bhutan)
--u-	BO	Bolivia (Republic of Bolivia)
---f	BW	Botswana (Republic of Botswana)
----	BV	Bouvet Island
BIUF	BR	Brazil (Federative Republic of Brazil)
----	BN	Brunei Darussalam
--UF	BG	Bulgaria (Republic of Bulgaria)
--u-	BF	Burkina Faso (formerly Upper Volta)
----	BI	Burundi (Republic of Burundi)
--uf	BY	Byelorussian SSR (Byelorussian Soviet Socialist Republic)
----*	CM	Cameroon (Republic of Cameroon)
BIUF	CA	Canada
----	CV	Cape Verde (Republic of Cape Verde)
----	KY	Cayman Islands
----	CF	Central African Republic
----	TD	Chad (Republic of Chad)
----	IO	Chagos Islands (Indian Ocean)
BIUf	CL	Chile (Republic of Chile)
--u-	CN	China (People's Republic of China)
----	CX	Christmas Island (Indian Ocean)
----	CI	Cote d'Ivoire (Republic of Cote d'Ivoire)
----	CC	Cocos Keeling Islands)
b-u-	CO	Colombia (Republic of Colombia)
----	KM	Comoros (Islamic Federal Republic of the Comoros)
----*	CG	Congo (People's Republic of the Congo)
----	CK	Cook Islands
b-u-	CR	Costa Rica (Republic of Costa Rica)
--u-	CU	Cuba (Republic of Cuba)
b-U-	CY	Cyprus (Republic of Cyprus)
BiUF	CS	Czechoslovakia (Czech and Slovak Federal Republic)
BIUF	DK	Denmark (Kingdom of Denmark)
----	DJ	Djibouti (Republic of Djibouti)
----	DM	Dominica (Commonwealth of Dominica)
--u-	DO	Dominican Republic
----	TP	East Timor
b-u-	EC	Ecuador (Republic of Ecuador)
b-u-	EG	Egypt (Arab Republic of Egypt)
----	SV	El Salvador (Republic of El Salvador)
----	GQ	Equatorial Guinea (Republic of Equatorial Guinea)
--UF	EW	Estonia
---f	ET	Ethiopia
----	FK	Falkland Islands (Malvinas)
----	FO	Faroe Islands
--u-	FJ	Fiji (Republic of Fiji)
BIUF	FI	Finland (Republic of Finland)
BIUF	FR	France (French Republic)
--u-	GF	French Guiana (Department of Guiana)
----*	PF	French Polynesia
----	TF	French Southern Territories
----	GA	Gabon (Gabonese Republic)
----	GM	Gambia (Republic of the Gambia)
BIUF	DE	Germany (Federal Republic of Germany)

----	GH	Ghana (Republic of Ghana)
----	GI	Gibraltar
BIUF	GR	Greece (Hellenic Republic)
---f	GL	Greenland
----	GD	Grenada
--u-	GP	Guadeloupe (French Department of Guadeloupe)
----	GU	Guam
--u-	GT	Guatemala (Republic of Guatemala)
----	GN	Guinea (Republic of Guinea)
----	GW	Guinea-Bissau (Republic of Guinea-Bissau)
----	GY	Guyana (Republic of Guyana)
----	HT	Haiti (Republic of Haiti)
----	HM	Heard and McDonald Islands
----	HN	Honduras (Republic of Honduras)
B--F	HK	Hong Kong (Hisiangkang, Xianggang)
biUF	HU	Hungary (Republic of Hungary)
-IUf	IS	Iceland (Republic of Iceland)
bIU-	IN	India (Republic of India)
--u-	ID	Indonesia (Republic of Indonesia)
----	IR	Iran (Islamic Republic of Iran)
----	IQ	Iraq (Republic of Iraq)
BIUF	IE	Ireland
BIuF	IL	Israel (State of Israel)
BIUF	IT	Italy (Italian Republic)
----	JM	Jamaica
BIUF	JP	Japan
----	JO	Jordan (Hashemite Kingdom of Jordan)
----	KH	Kampuchea, Democratic (formerly Cambodia)
----*	KE	Kenya (Republic of Kenya)
----	KI	Kiribati (Republic of Kiribati)
----	KP	Korea, Democratic People's Republic of
BIUf	KR	Korea, Republic of Korea
b---	KW	Kuwait (State of Kuwait)
----	LA	Lao People's Democratic Republic
--UF	LV	Latvia
----	LB	Lebanon (Lebanese Republic)
----*	LS	Lesotho (Kingdom of Lesotho)
----	LR	Liberia (Republic of Liberia)
----	LY	Libyan Arab Jamahiriya (Socialist Peoples's Libyan Arab Jamahiriya)
----	LI	Liechtenstein (Principality of Liechtenstein)
--uF	LT	Lithuania
b-uF	LU	Luxembourg (Grand Duchy of Luxembourg)
---F	MO	Macau (Ao-me'n)
----	MG	Madagascar (Democratic Republic of Madagascar)
----	MW	Malawi (Republic of Malawi)
b-uF	MY	Malaysia
----	MV	Maldives (Republic of Maldives)
--u-	ML	Mali (Republic of Mali)
----	MT	Malta (Republic of Malta)
----	MH	Marshall Islands (Republic of the Marshall Islands)
--u-	MQ	Martinique (French Department of Martinique)
----	MR	Mauritania (Islamic Republic of Mauritania)
----	MU	Mauritius
BIuf	MX	Mexico (United Mexican States)
----	FM	Micronesia (Federated States of Micronesia)
----	MC	Monaco (Principality of Monaco)
----	MN	Mongolia (Mongolian People's Republic)
----	MS	Montserrat
----	MA	Morocco (Kingdom of Morocco)
----*	MZ	Mozambique (Republic of Mozambique)

---- MM Myanmar (Union of Myanmar)
--u- NA Namibia (Republic of Namibia)
---- NR Nauru (Republic of Nauru)
---- NP Nepal (Kingdom of Nepal)
BIUF NL Netherlands (Kingdom of the Netherlands)
---- AN Netherlands Antilles
---- NT Neutral Zone (between Saudi Arabia and Iraq)
--u- NC New Caledonia
-IuF NZ New Zealand
--u- NI Nicaragua (Republic of Nicaragua)
--u- NE Niger (Republic of the Niger)
---- NG Nigeria (Federal Republic of Nigeria)
---- NU Niue
---- NF Norfolk Island
---- MP Northern Mariana Islands (Commonwealth of the
Northern Mariana Islands)
BIUF NO Norway (Kingdom of Norway)
---- OM Oman (Sultanate of Oman)
---- PK Pakistan (Islamic Republic of Pakistan)
---- PW Palau (Republic of Palau)
---- PA Panama (Republic of Panama)
--u- PG Papua New Guinea
--u- PY Paraguay (Republic of Paraguay)
x-u- PE Peru (Republic of Peru)
--uF PH Philippines (Republic of the Philippines)
---- PN Pitcairn Island
biUF PL Poland (Republic of Poland)
bIUF PT Portugal (Portuguese Republic)
BIUF PR Puerto Rico
---- QA Qatar (State of Qatar)
----* RE Re'union (French Department of Re'union)
----* RO Romania
---- RW Rwanda (Rwandese Republic)
---- SH Saint Helena
---- KN Saint Kitts and Nevis
---- LC Saint Lucia
---- PM Saint Pierre and Miquelon (French Department of Saint
Pierre and Miquelon)
---- VC Saint Vincent and the Grenadines
---- SM San Marino (Republic of San Marino)
---- ST Sao Tome and Principe (Democratic Republic of Sao
Tome and Principe)
B--- SA Saudi Arabia (Kingdom of Saudi Arabia)
--u- SN Senegal (Republic of Senegal)
--u- SC Seychelles (Republic of Seychelles)
-- - SL Sierra Leone (Republic of Sierra Leone)
bIuF SG Singapore (Republic of Singapore)
---- SB Solomon Islands
---- SO Somalia (Somali Democratic Republic)
-IUF ZA South Africa (Republic of South Africa)
BIUF ES Spain (Kingdom of Spain)
--u- LK Sri Lanka (Democratic Socialist Republic of Sri
Lanka)
---- SD Sudan (Republic of the Sudan)
---- SR Suriname (Republic of Suriname)
---- SJ Svalbard and Jan Mayen Islands
---- SZ Swaziland (Kingdom of Swaziland)
BIUF SE Sweden (Kingdom of Sweden)
BIUF CH Switzerland (Swiss Confederation)
---- SY Syria (Syrian Arab Republic)
B-uF TW Taiwan

```
 ----   TZ   Tanzania (United Republic of Tanzania)
 --uF   TH   Thailand (Kingdom of Thailand)
 --u-   TG   Togo (Togolese Republic)
 ----   TK   Tokelau
 ----   TO   Tonga (Kingdom of Tonga)
 ----   TT   Trinidad and Tobago (Republic of Trinidad and Tobago)
 bI--   TN   Tunisia
 B---   TR   Turkey (Republic of Turkey)
 ----   TC   Turks and Caicos Islands
 ----   TV   Tuvalu
 b-UF   SU   USSR (Union of Soviet Socialist Republics)
 ----   UG   Uganda (Republic of Uganda)
 --UF   UA   Ukrainian SSR (Ukrainian Soviet Socialist Republic)
 ----   AE   United Arab Emirates
 bIUF   GB   United Kingdom (United Kingdom of Great Britain and
Northern Ireland)
 BIUF   US   United States (United States of America)
 ----   UM   United States Minor Outlying Islands
 x-uf   UY   Uruguay (Eastern Repuplic of Uruguay)
 ----*  VU   Vanuatu (Republic of Vanuatu, formerly New Hebrides)
 ----   VA   Vatican City State
 --u-   VE   Venezuela (Republic of Venezuala)
 ----   VN   Vietnam (Socialist Republic of Vietnam)
 ----   VG   Virgin Islands, British
 ----   VI   Virgin Islands, U.S. (Virgin Islands of the United
States)
 ----   WF   Wallis and Futuna Islands
 ----   EH   Western Sahara
 ----   WS   Western Samoa (Independent State of Western Samoa)
 ----   YE   Yemen (Republic of Yemen)
 ----   YD   Yemen, Democratic (People's Democratic Republic of
Yemen)
 B-U-   YU   Yugoslavia (Socialist Federal Republic of Yugoslavia)
 ----   ZR   Zaire (Republic of Zaire)
 ----*  ZM   Zambia (Republic of Zambia)
 ---f   ZW   Zimbabwe (Republic of Zimbabwe)
```

Figure A2.7: A simplified version of an International Connectivity map used as an illustration in a research monograph. (Source: author scan from Castells 1998, 94.)

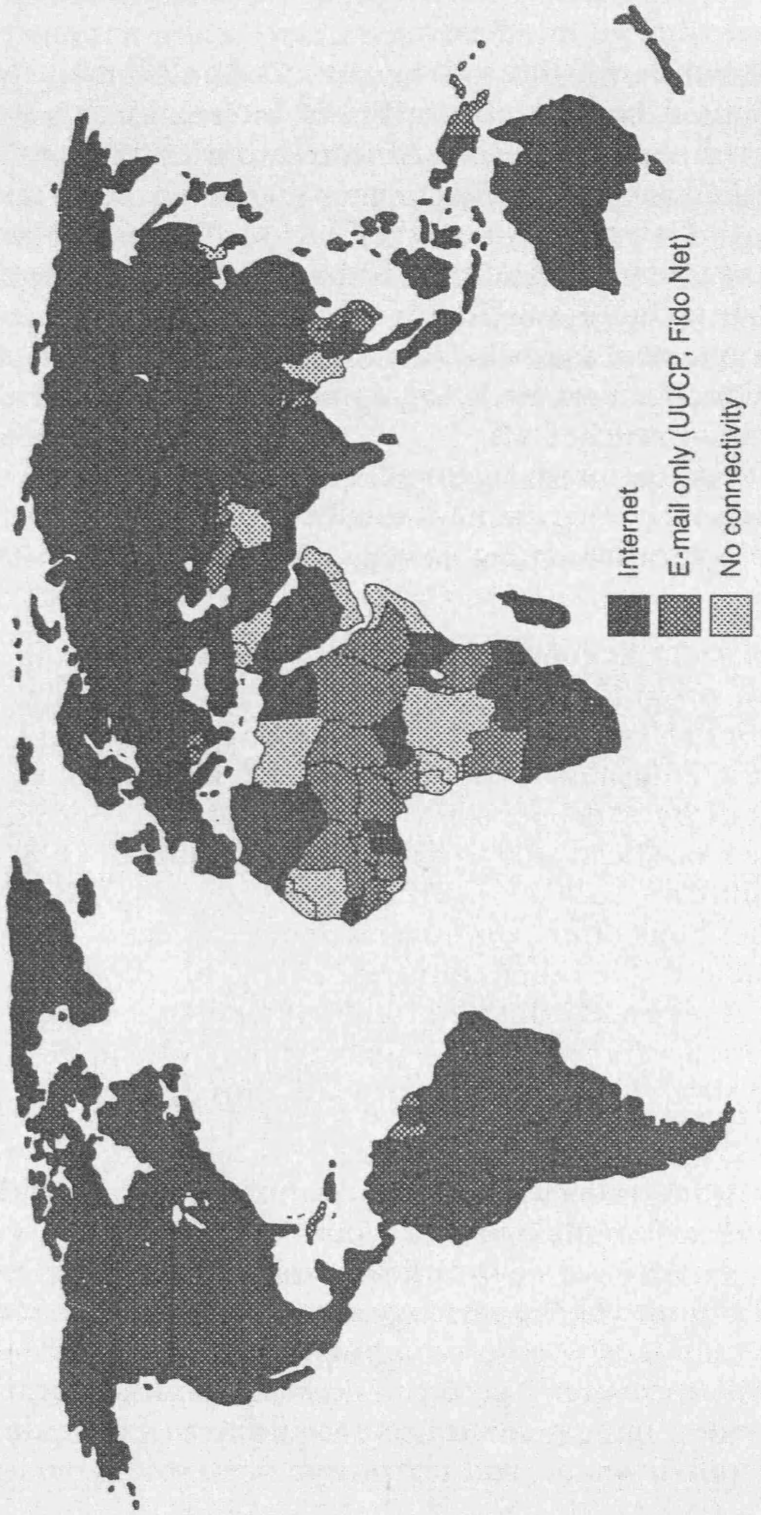

Figure 2.2 International connectivity

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Figure A2.8: Modified versions of two International Connectivity maps used as an illustrations in a policy document by the Brazilian government. (Source: Ministerio de Ciencia y Tecnología, 2001, 4.)

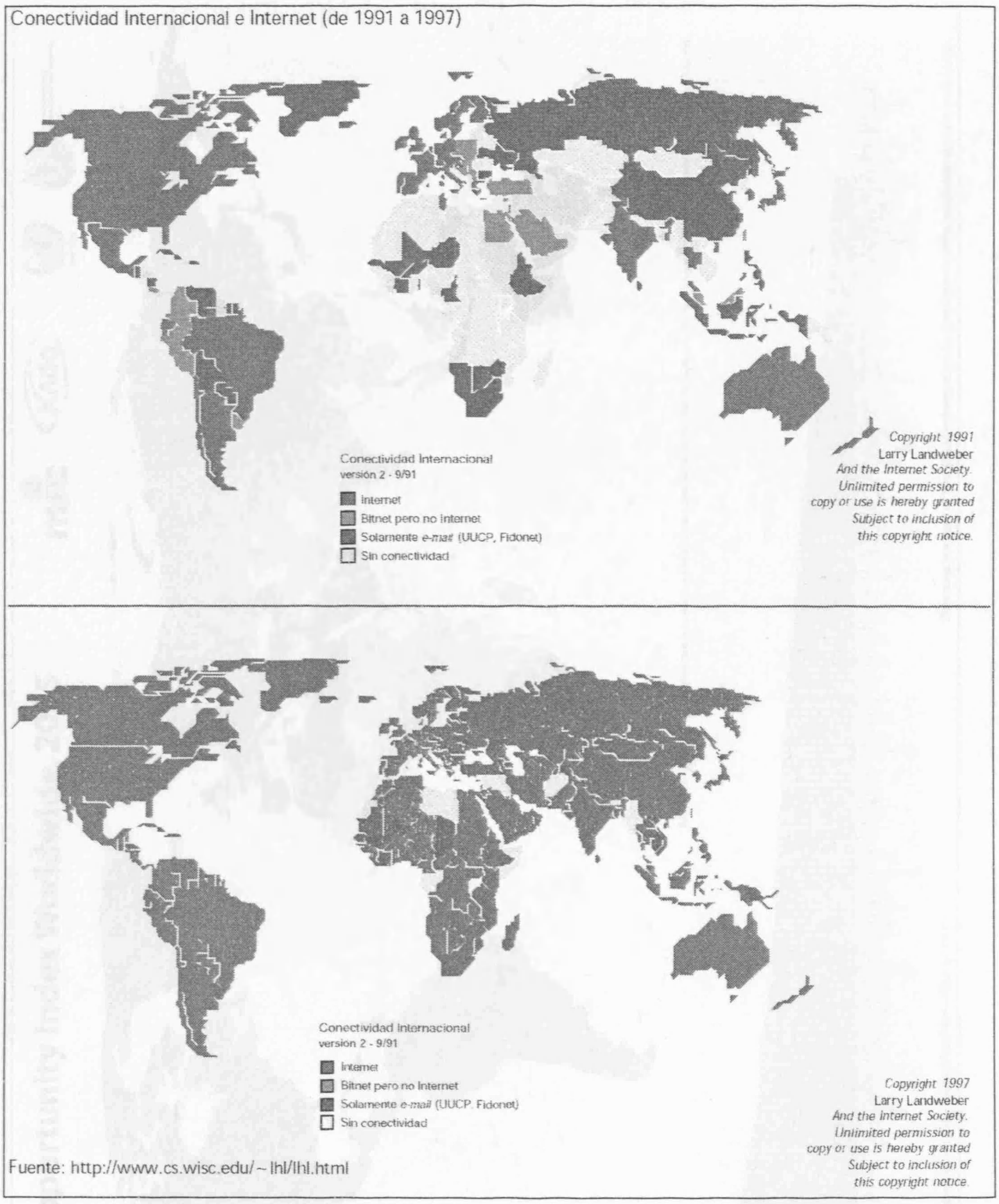


Figure A2.9: Digital Opportunity Index Worldwide, 2005, produced by the International Telecommunication Union. (Source: <www.itu.int/osg/spu/publications/worldinformationsociety/2006/World.pdf>.)

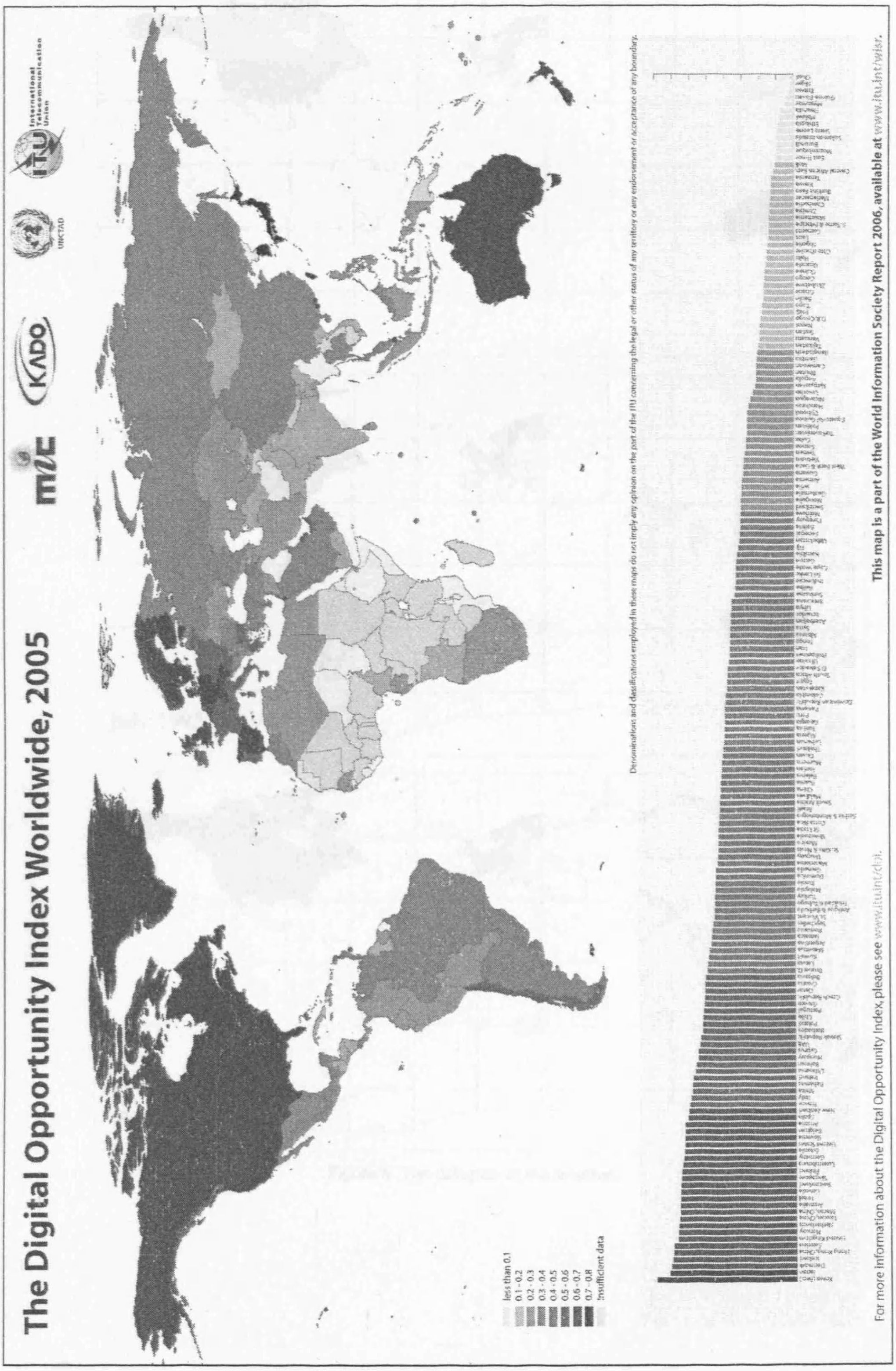


Figure A2.10: The growth of Internet hosts mapped at regular intervals through 1991-1994. Countries only appear on the map only once they had an Internet connection. (Source: author scan from Batty and Barr 1994, 707-708.)

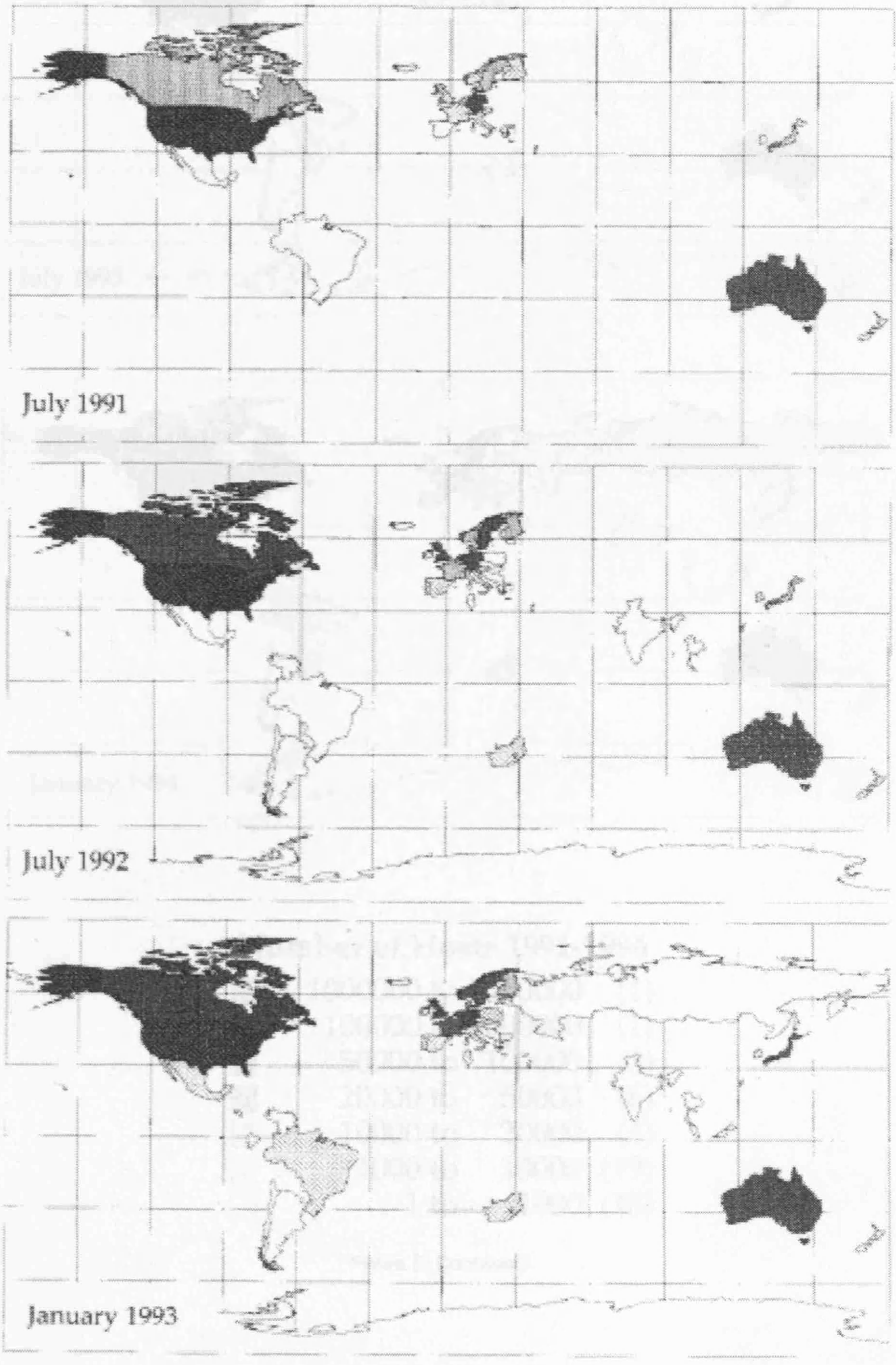


Figure 5. The diffusion of the Internet.

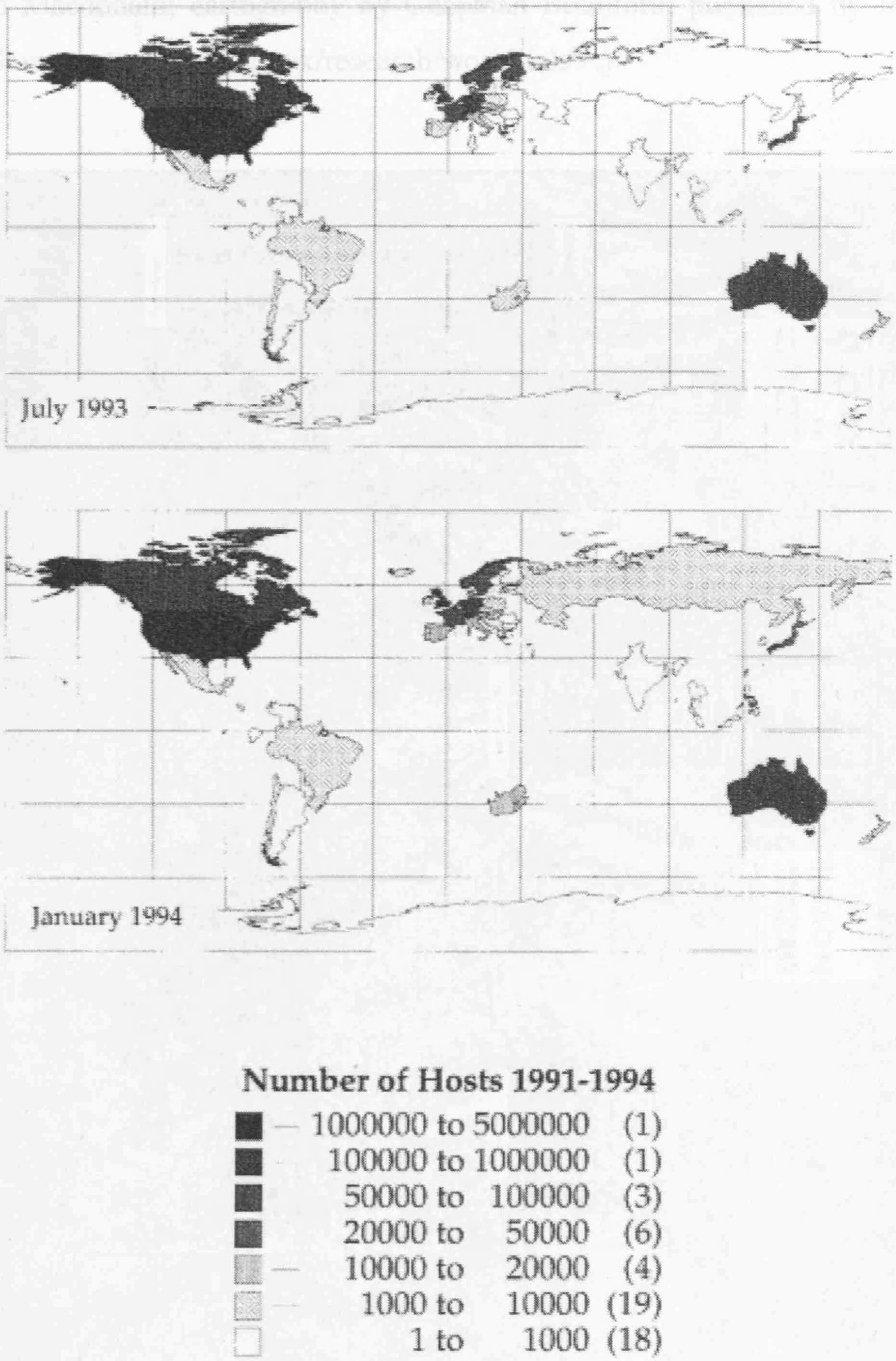


Figure 5. Continued.

Figure A2.11: The 'Network Society Map', 1997. Map research and conception by Nico Macdonald; cartography by Chapman Bounford; published by World Link. (Source: <www.spy.co.uk/research/worldlink/>.)

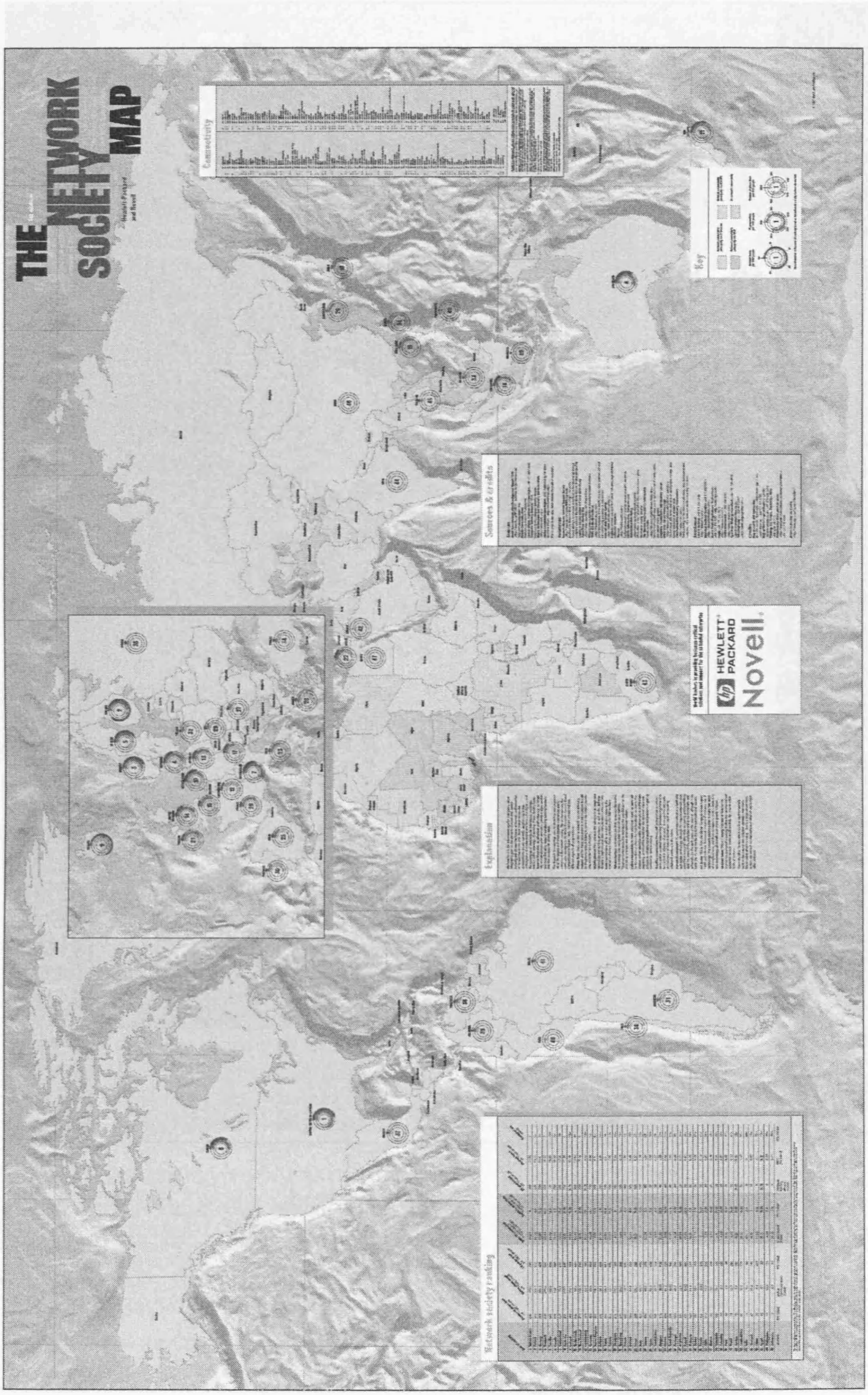


Figure A2.12: 'Wired Countries of the World' produced by World Information Access Project, 2007. (Source: <http://wiareport.org>.)

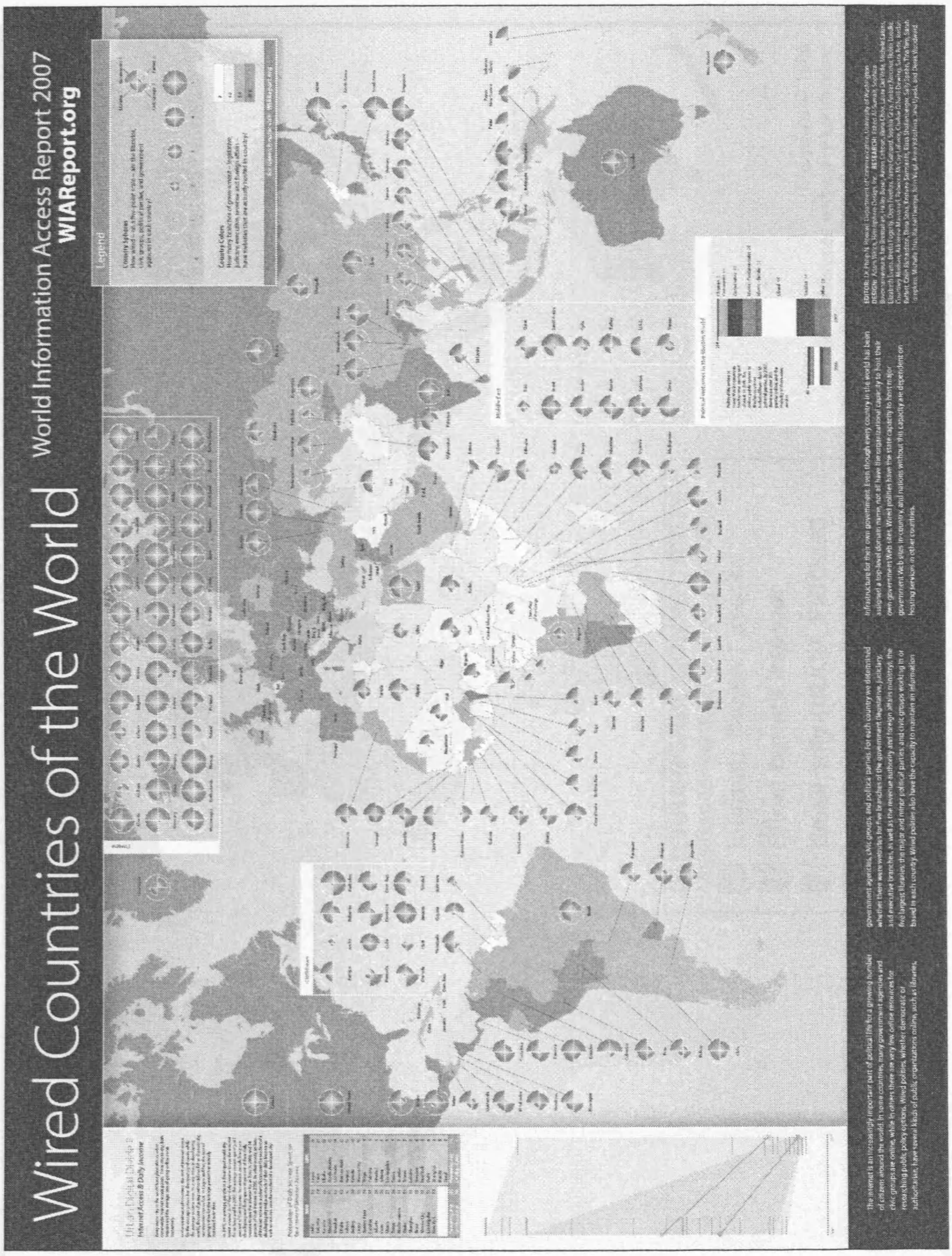


Figure A2.13: A dasymetric version of the International Connectivity map produced by Mike Holderness, 1996. (Source: <www.poptel.org.uk/nuj/mike/cyberdiv.htm>.)

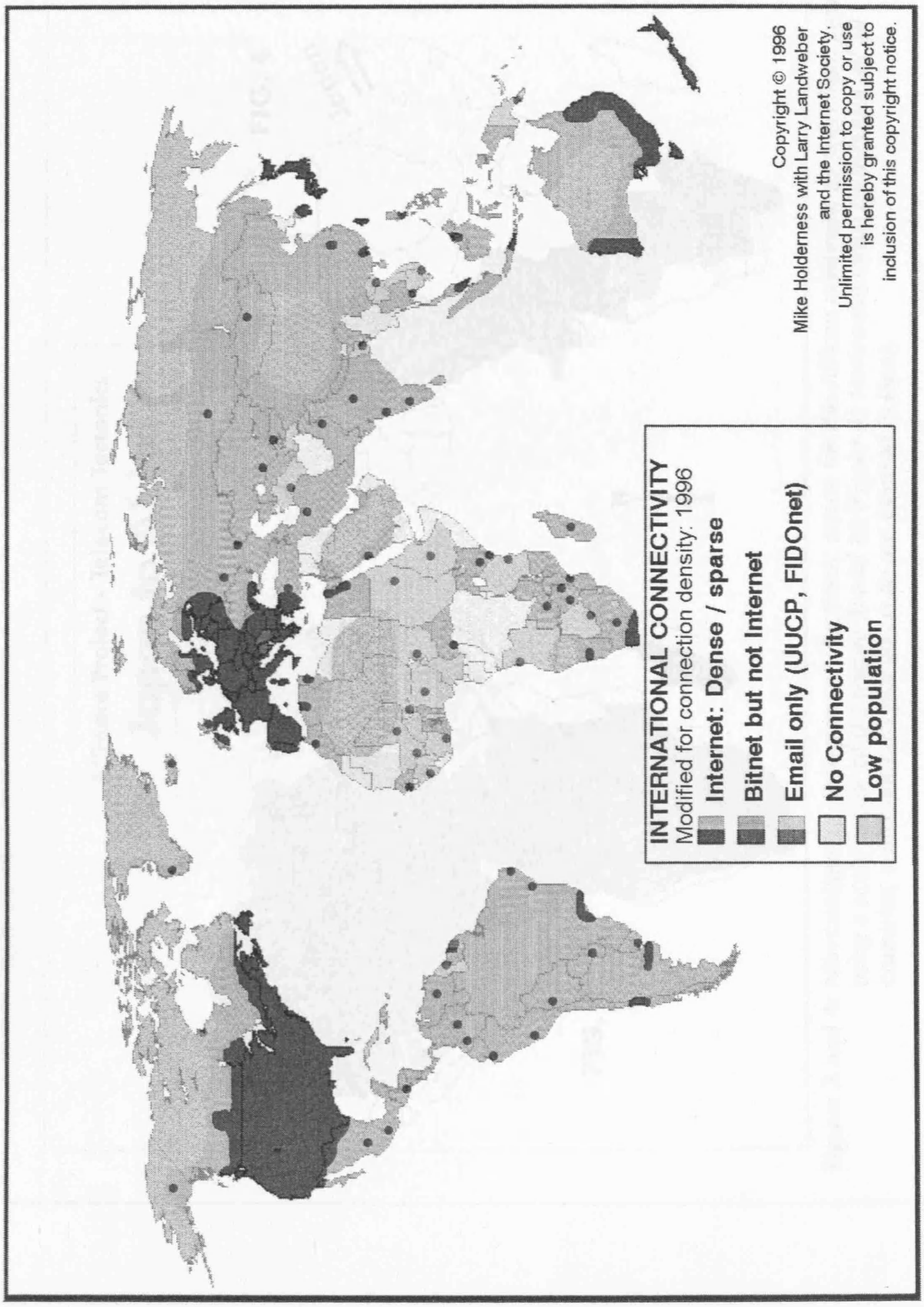
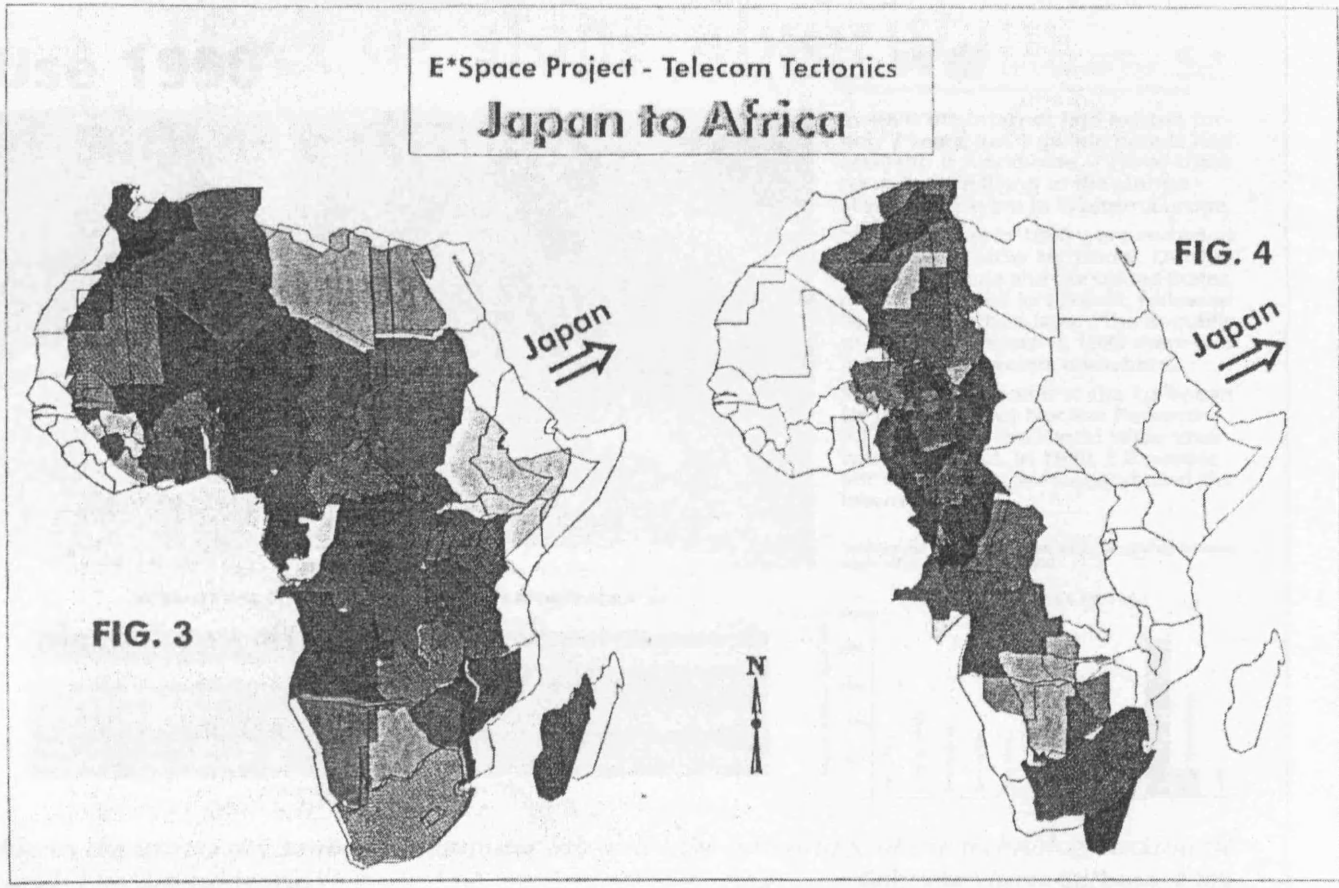


Figure A2.14: Distance-based cartogram produced by Colin Arrowsmith
(Source: author scan from Arrowsmith and Wilson 1998, 7.)



Figures 3 and 4: *Non-contiguous cartogram of electronic space for the African continent as seen from Japan using a scale factor of 0.2 (Figure 3) and 1.0 (Figure 4). Notice the radial distribution of all countries, with centroids placed on an arc centred in Japan.*

Figure A2.15: Internet users per capita 1990 cartogram poster, produced by the Worldmapper project, 2006. (Source: <www.worldmapper.org/display.php?selected=335>.)

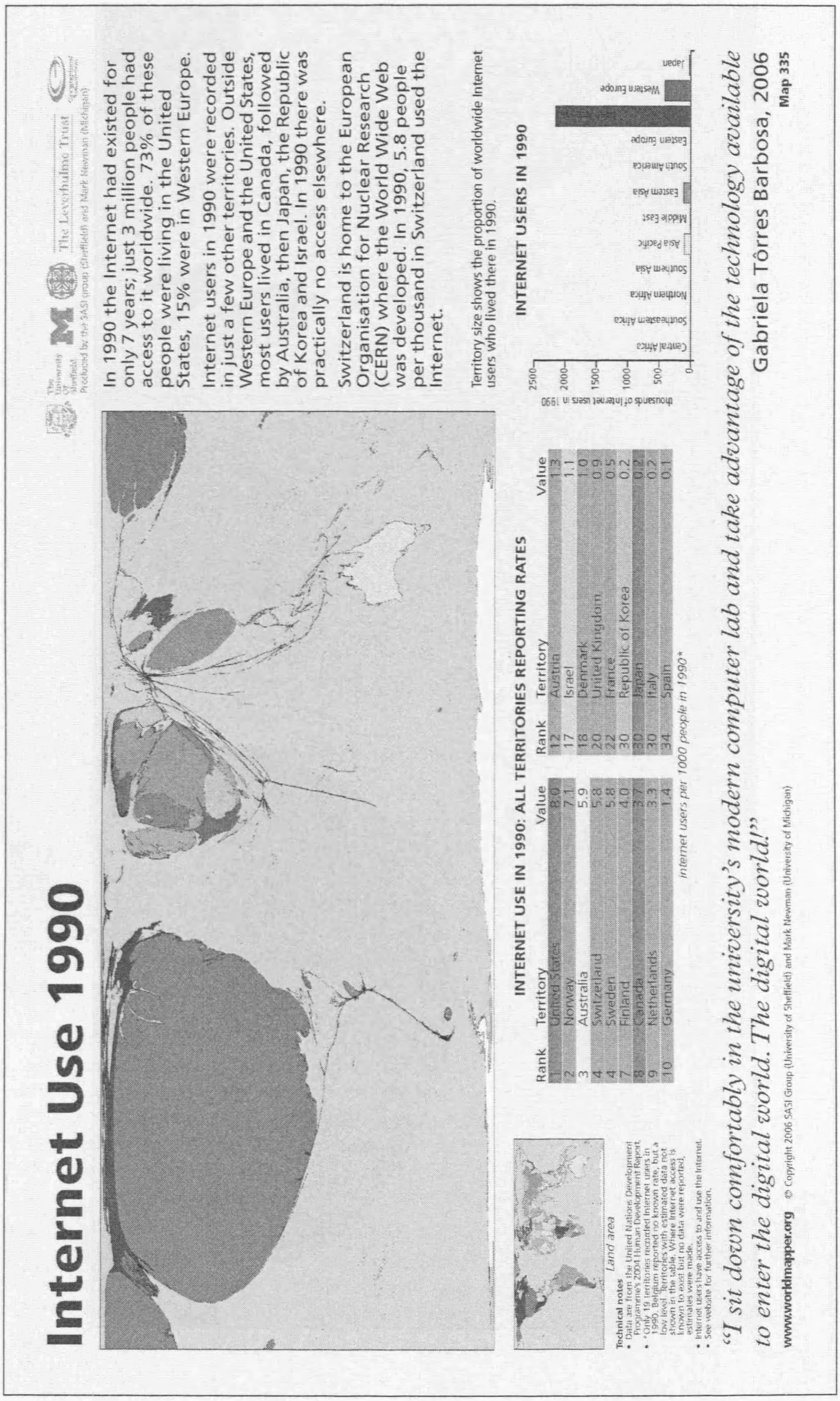
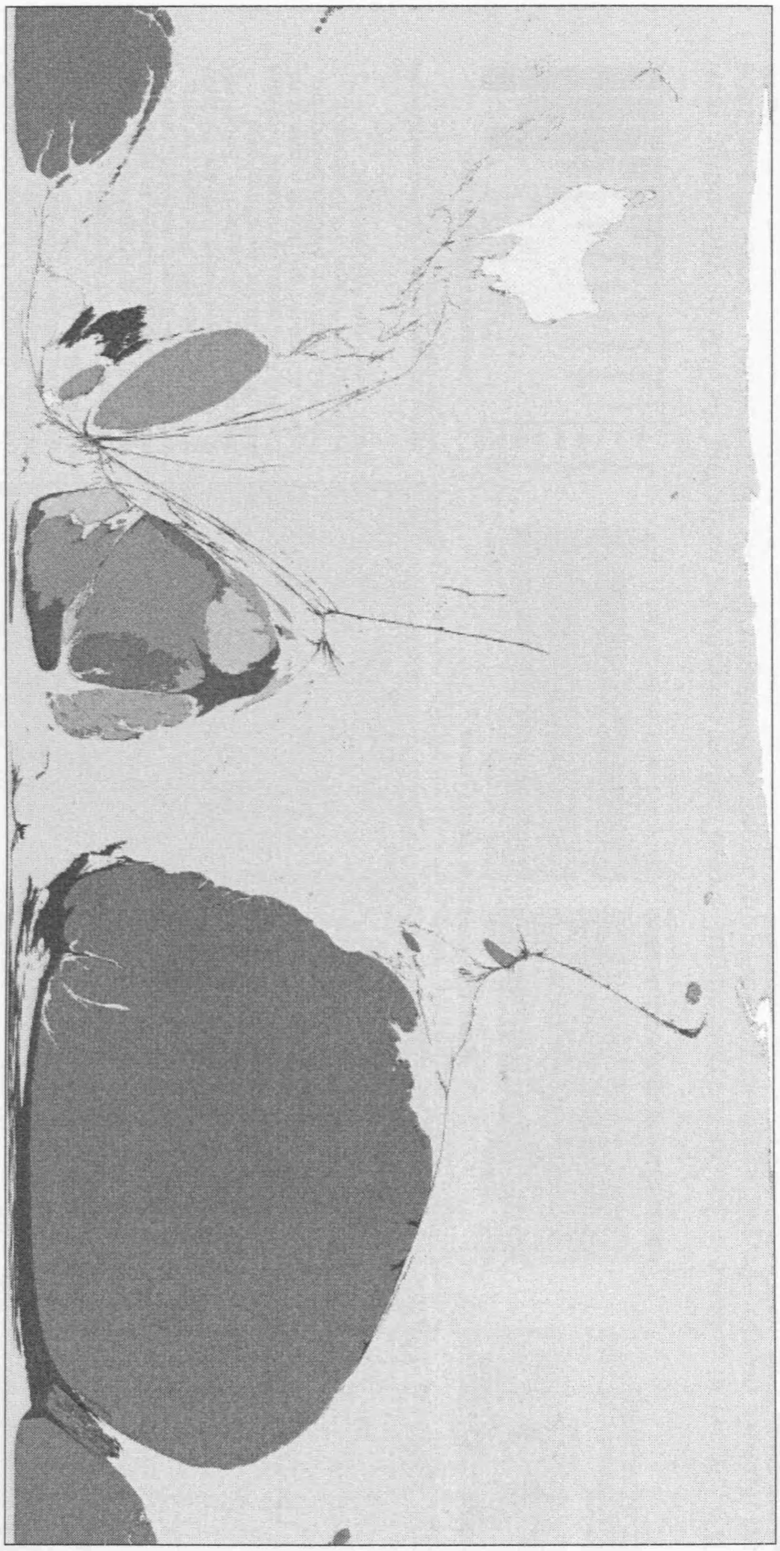
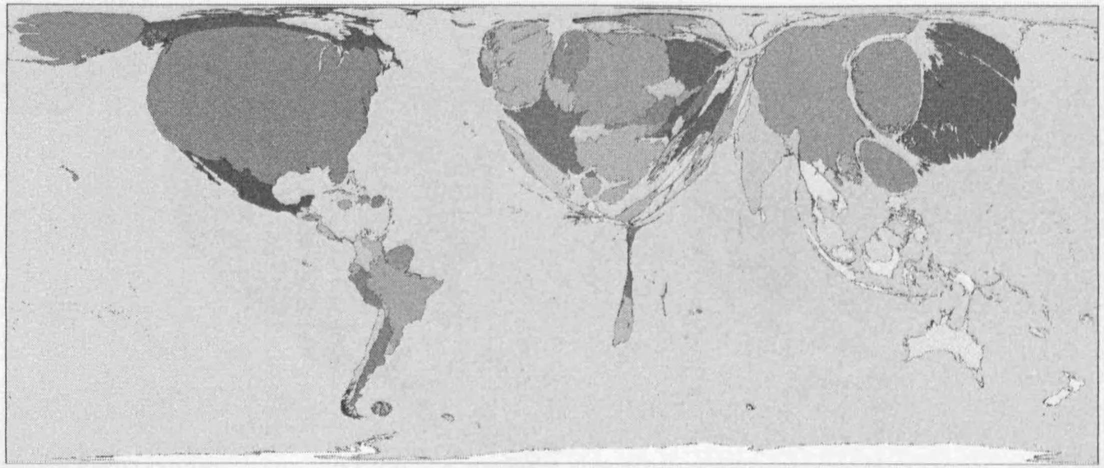


Figure A2.16: Full size view of Internet users per capita 1990 cartogram, produced by the Worldmapper project, 2006. (Source: <www.worldmapper.org/display.php?selected=335>.)



Internet Users 2002

Produced by the SASI group (Sheffield) and Mark Newman (Michigan)



During the 12 years from 1990 to 2002, people using the Internet increased in number by 224 times. By 2002 there were 631 million Internet users worldwide.

The distribution of Internet users worldwide has changed remarkably over just a dozen years. In 1990 Internet users were mainly found in the United States, Western Europe, Australia, Japan and Taiwan. By 2002 people living in Asia Pacific, Southern Asia, South America, China and Eastern Europe were notable Internet users. A not insignificant number of Internet users are also shown to be in Northern Africa, Southeastern Africa and the Middle East.

Territory size shows the proportion of worldwide Internet users who lived there in 2002.

Land area

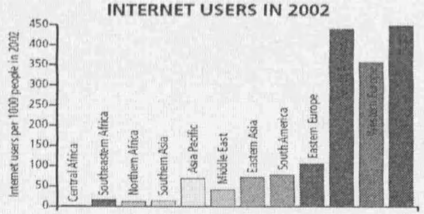
Technical notes
- Data are from the United Nations Development Programme's 2004 Human Development Report.
- Internet users have access to and use the Internet.
- See website for further information.

MOST AND FEWEST INTERNET USERS

Rank	Territory	Value	Rank	Territory	Value
1	Iceland	648	191	Bangladesh	1.5
2	Sweden	573	191	Congo	1.5
3	Republic of Korea	552	193	Niger	1.3
4	United States	551	193	Central African Republic	1.3
5	Denmark	513	195	Burundi	1.2
5	Canada	513	196	Iraq	1.0
7	Finland	509	197	Democratic Republic of Congo	0.9
8	Netherlands	506	198	Ethiopia	0.7
9	Singapore	504	199	Myanmar	0.5
10	Norway	503	199	Tajikistan	0.5

Internet users per 1000 people in 2002

INTERNET USERS IN 2002



"We [strive] to achieve a 'warm-hearted digital world' where everybody, including the elderly, the young, men and women, enjoys ubiquitous access to communications technologies for the greater good ..." Yeon Gi Son, 2006

www.worldmapper.org

Map 336

Figure A2.17: Internet users per capita 2002 cartogram poster, produced by the Worldmapper project, 2006. (Source: <www.worldmapper.org/display.php?selected=336>.)

Figure A2.18: Full size view of Internet users per capita 2002 cartogram, produced by the Worldmapper project, 2006. (Source: <www.worldmapper.org/display.php?selected=336>.)

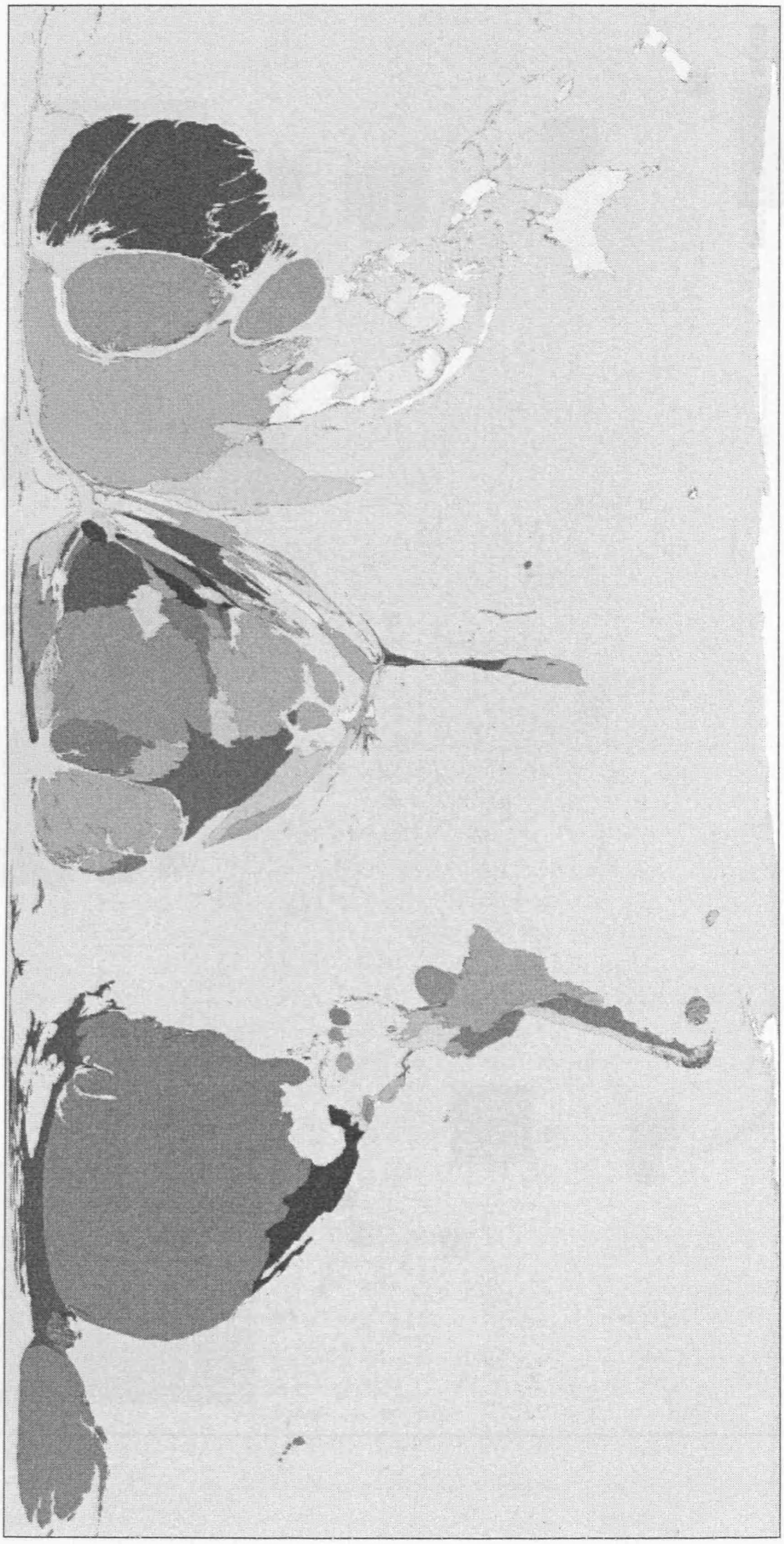


Figure A2.19: Internet users 2005 cartogram produced by ExploMap Technologies, 2007. (Source: <http://explomap.free.fr/world_map_internet_users_2005.pdf>

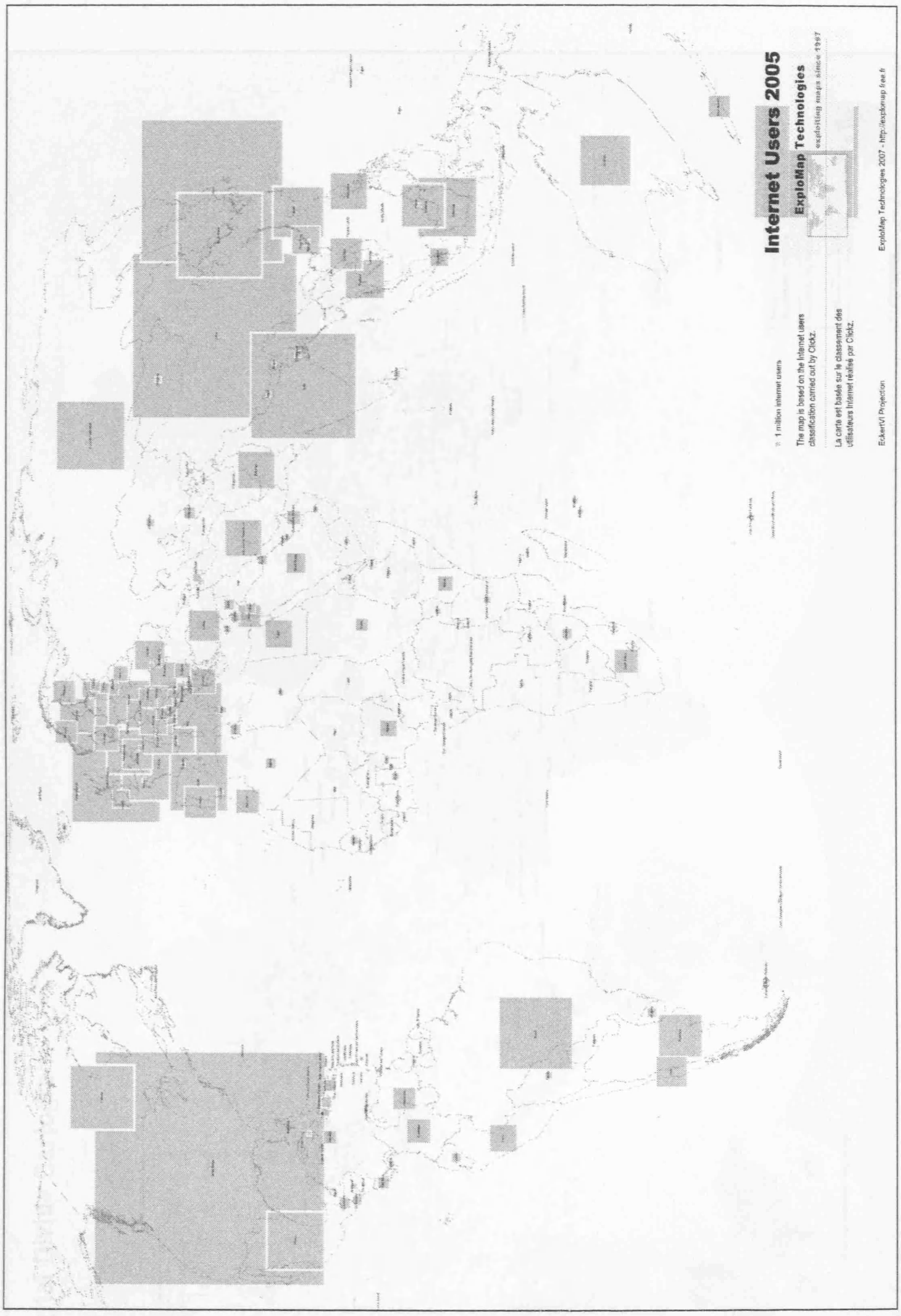


Figure A2.20: Digital divide cartogram produced by Govcom.org, April 2005. Country size is inversely proportional to level of Internet usage. (Source: <www.govcom.org/maps/map_set_wsis/GC0_Maps_set_3.0_digitaldivide_invert.pdf>.)

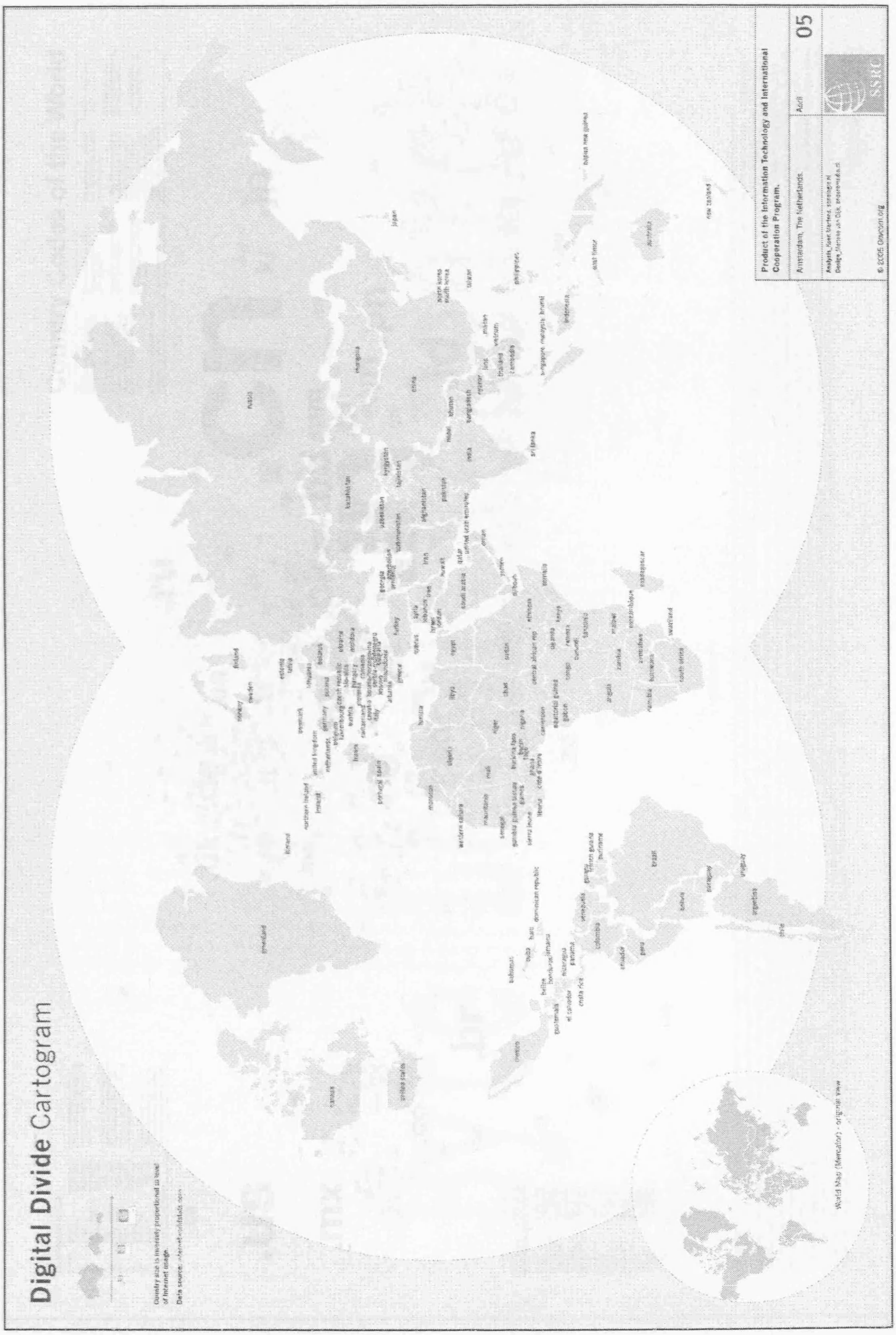


Figure A2.21: Country codes of the world cartogram produced by Byte Level Research. Countries represented by their two letter Internet domain names and sized proportionally to their population. (Source: <www.bytelevel.com/map/ccTLD.html>.)

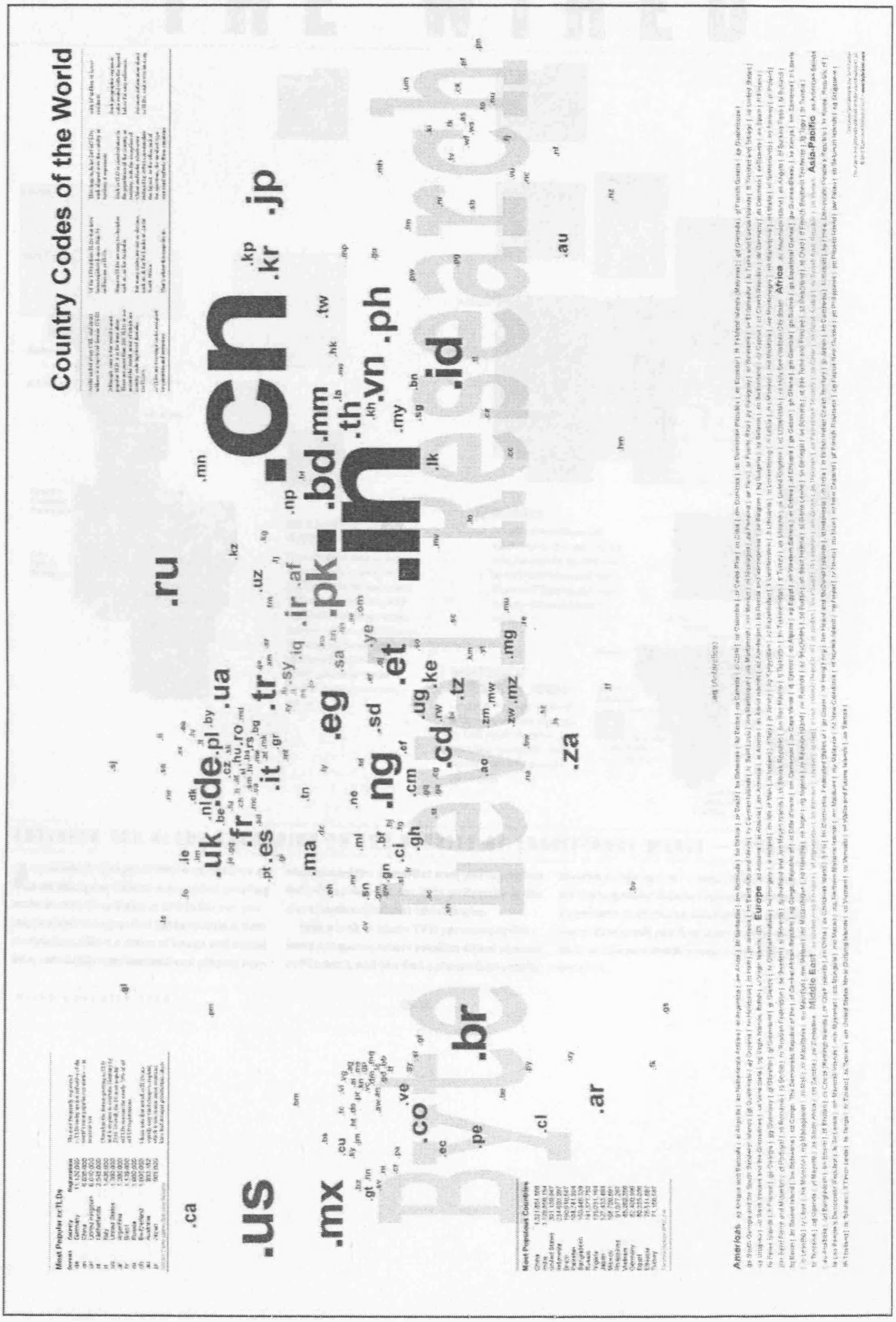
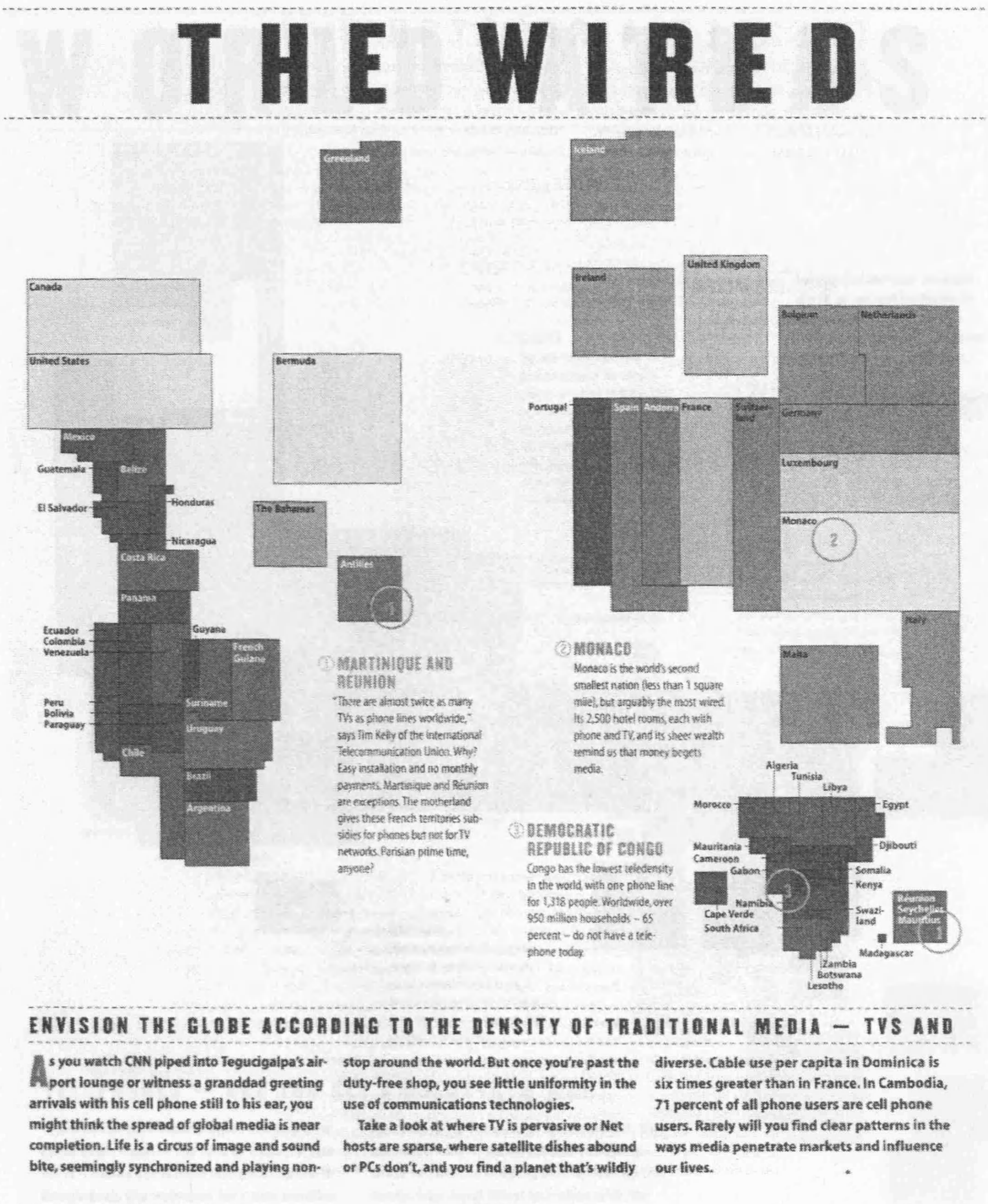


Figure A2.22: First page of 'The Wired World Atlas' produced by Wired magazine. (Source: author scan from original, Conners-Petersen 1988, 162.)



① MARTINIQUE AND REUNION

"There are almost twice as many TVs as phone lines worldwide," says Tim Kelly of the International Telecommunication Union. Why? Easy installation and no monthly payments. Martinique and Réunion are exceptions. The motherland gives these French territories subsidies for phones but not for TV networks. Parisian prime time, anyone?

② MONACO

Monaco is the world's second smallest nation (less than 1 square mile), but arguably the most wired. Its 2,500 hotel rooms, each with phone and TV, and its sheer wealth remind us that money begets media.

③ DEMOCRATIC REPUBLIC OF CONGO

Congo has the lowest teledensity in the world, with one phone line for 1,318 people. Worldwide, over 950 million households – 65 percent – do not have a telephone today.

ENVISION THE GLOBE ACCORDING TO THE DENSITY OF TRADITIONAL MEDIA — TVS AND

As you watch CNN piped into Tegucigalpa's airport lounge or witness a granddad greeting arrivals with his cell phone still to his ear, you might think the spread of global media is near completion. Life is a circus of image and sound bite, seemingly synchronized and playing nonstop around the world. But once you're past the duty-free shop, you see little uniformity in the use of communications technologies.

Take a look at where TV is pervasive or Net hosts are sparse, where satellite dishes abound or PCs don't, and you find a planet that's wildly diverse. Cable use per capita in Dominica is six times greater than in France. In Cambodia, 71 percent of all phone users are cell phone users. Rarely will you find clear patterns in the ways media penetrate markets and influence our lives.

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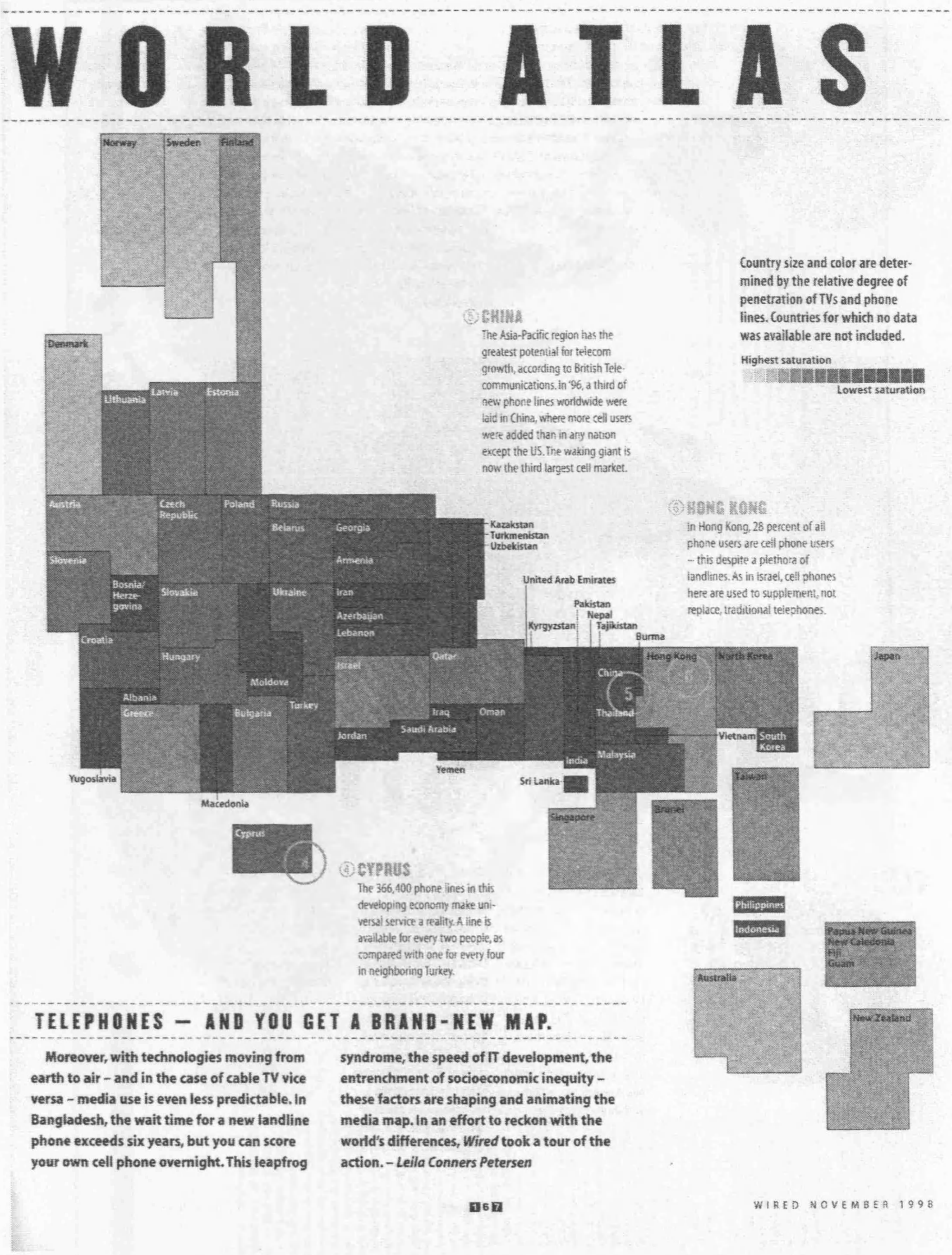
Figure A2.23: Second page of 'The Wired World Atlas' produced by Wired magazine. (Source: author scan from original, Conners-Petersen 1988, 167.)



WORLD ATLAS

Country size and color are determined by the relative degree of penetration of TVs and phone lines. Countries for which no data was available are not included.

Highest saturation

Lowest saturation

⑤ CHINA

The Asia-Pacific region has the greatest potential for telecom growth, according to British Telecommunications. In '96, a third of new phone lines worldwide were laid in China, where more cell users were added than in any nation except the US. The waking giant is now the third largest cell market.

⑥ HONG KONG

In Hong Kong, 28 percent of all phone users are cell phone users – this despite a plethora of landlines. As in Israel, cell phones here are used to supplement, not replace, traditional telephones.

④ CYPRUS

The 366,400 phone lines in this developing economy make universal service a reality. A line is available for every two people, as compared with one for every four in neighboring Turkey.

TELEPHONES – AND YOU GET A BRAND-NEW MAP.

Moreover, with technologies moving from earth to air – and in the case of cable TV vice versa – media use is even less predictable. In Bangladesh, the wait time for a new landline phone exceeds six years, but you can score your own cell phone overnight. This leapfrog syndrome, the speed of IT development, the entrenchment of socioeconomic inequity – these factors are shaping and animating the media map. In an effort to reckon with the world's differences, *Wired* took a tour of the action. – *Leila Conners Petersen*

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Figure A2.24: Freedom to Connect, produced by Wired magazine, August 1997. (Source: scanned version from Harpold 1999, no pagination.)

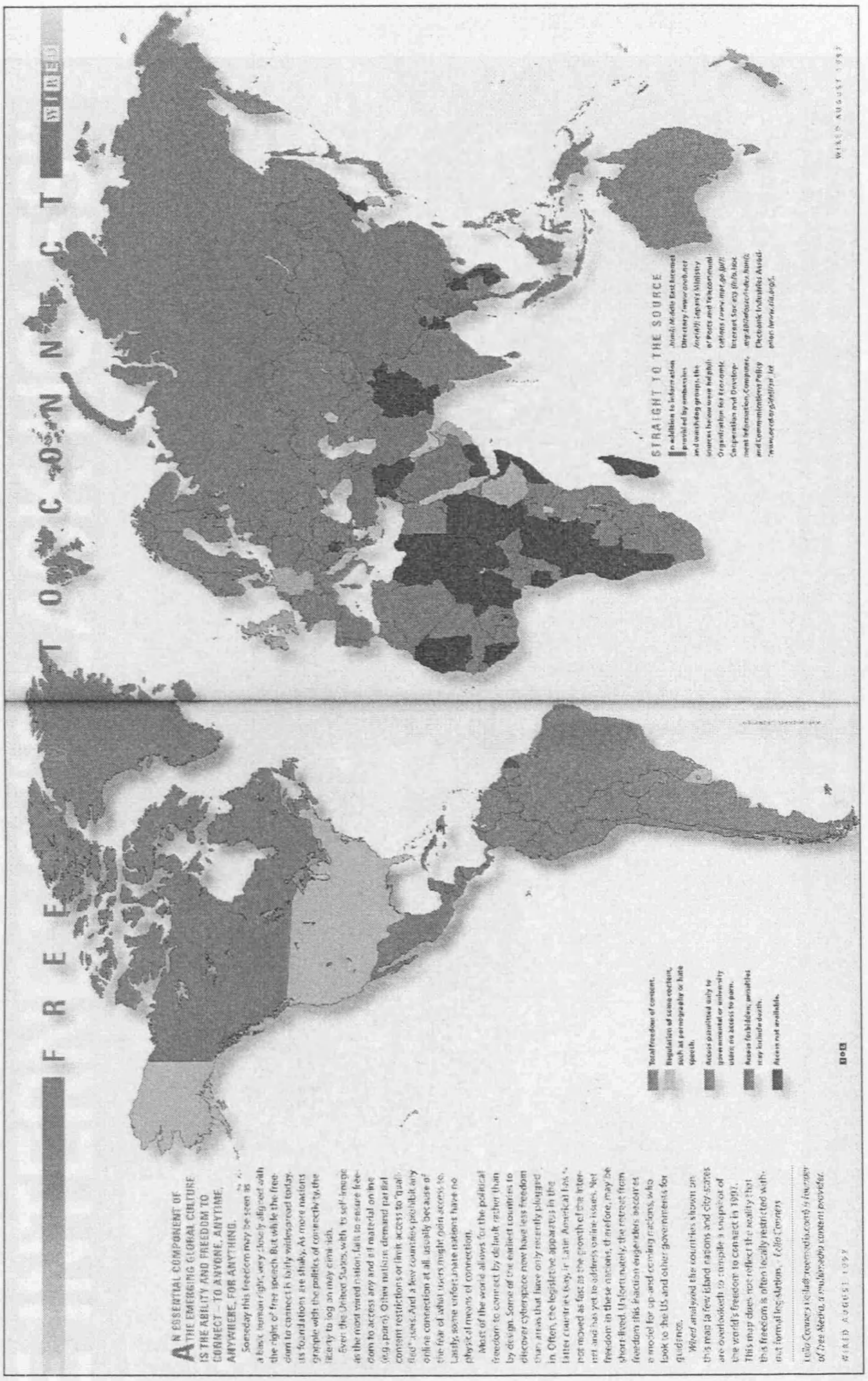
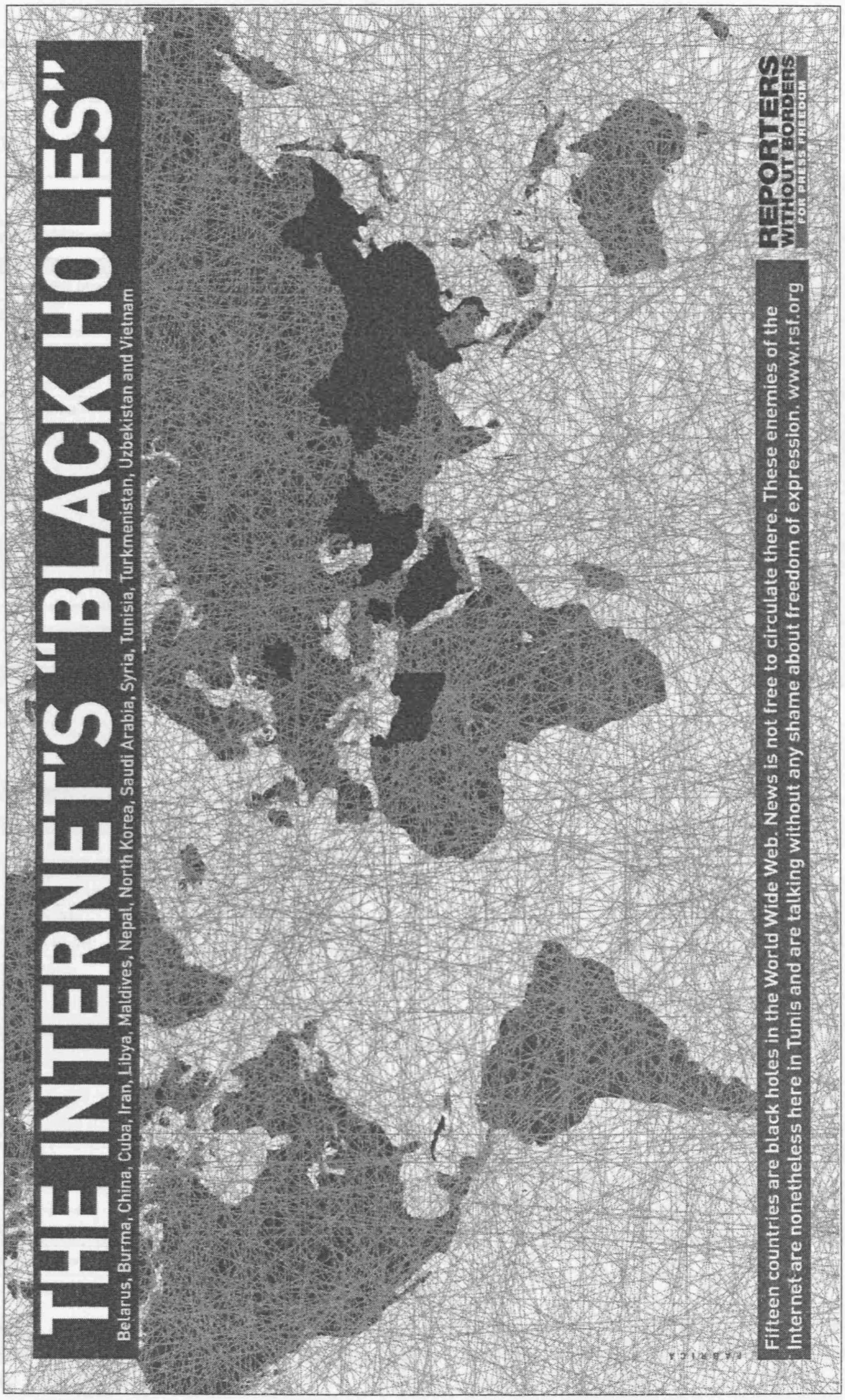


Figure A2.25: Internet's 'black holes' produced by Reporters without Borders as part of a campaign against online surveillance and censorship. (Source: <www.rsf.org>.)

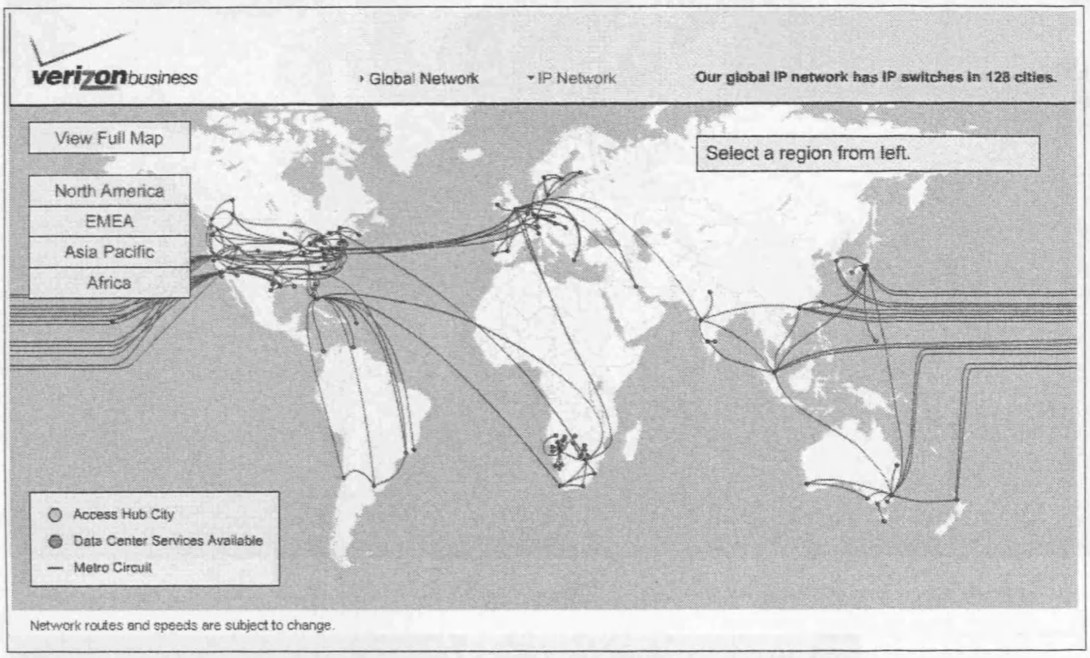


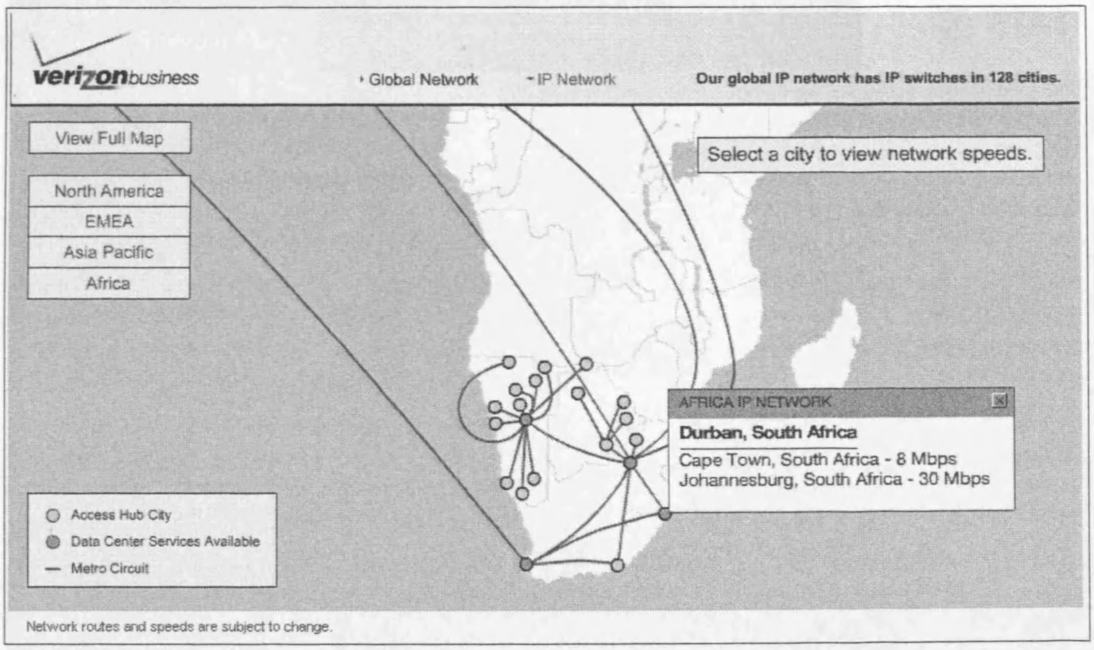
Appendix Three

Network Marketing Maps from Website Survey[1], August 2007

1. Verizon Business (USA), <www.verizonbusiness.com>

Source: <www.verizonbusiness.com/us/about/network/?link=topnav>

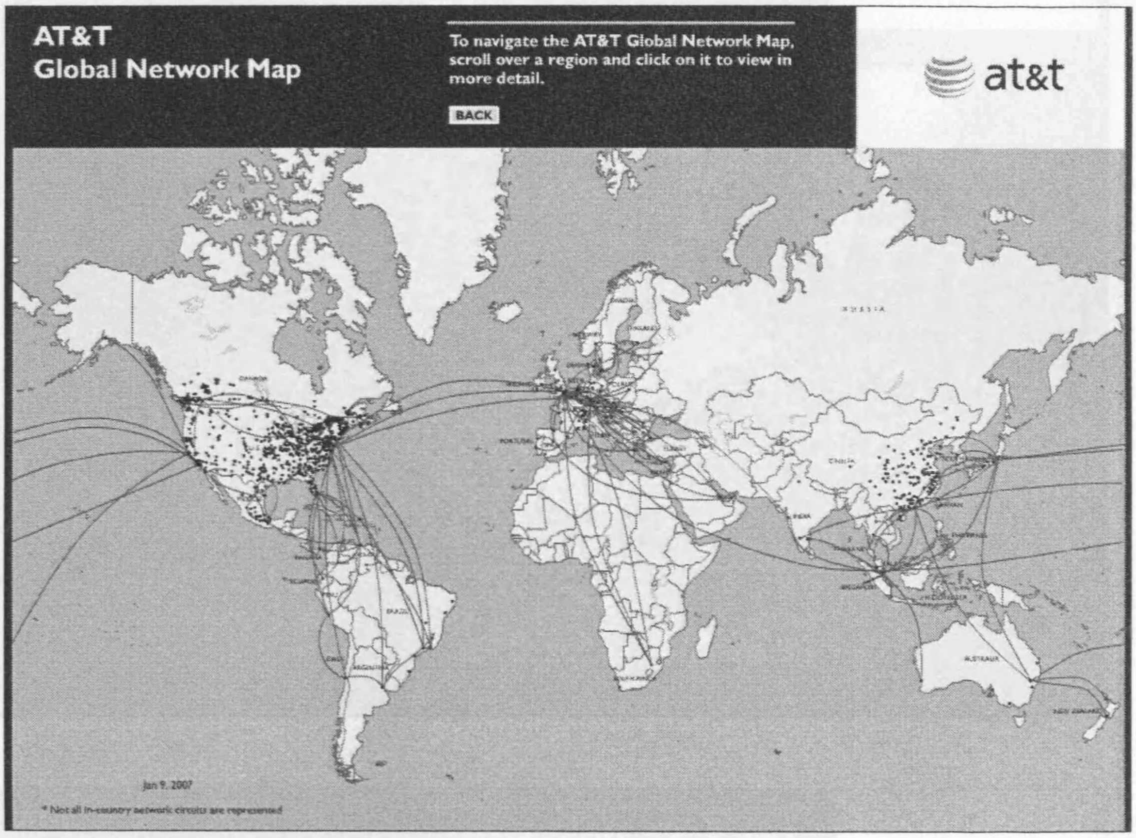


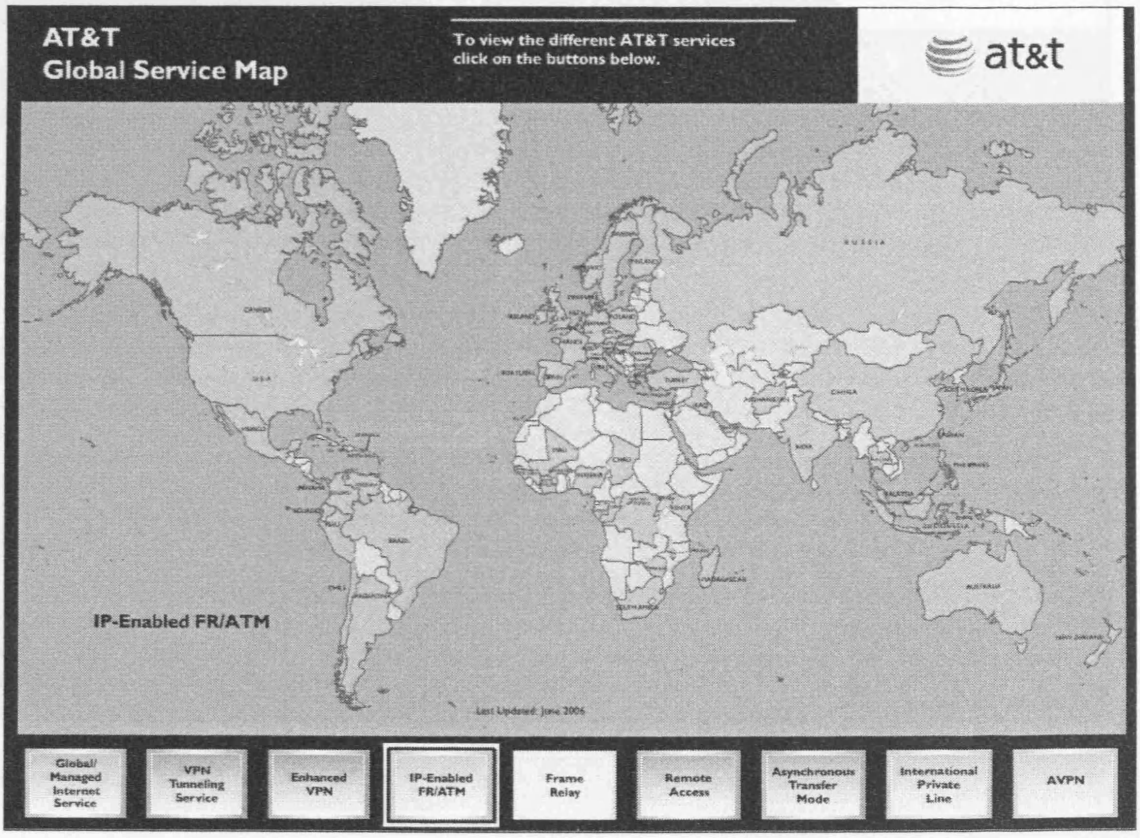


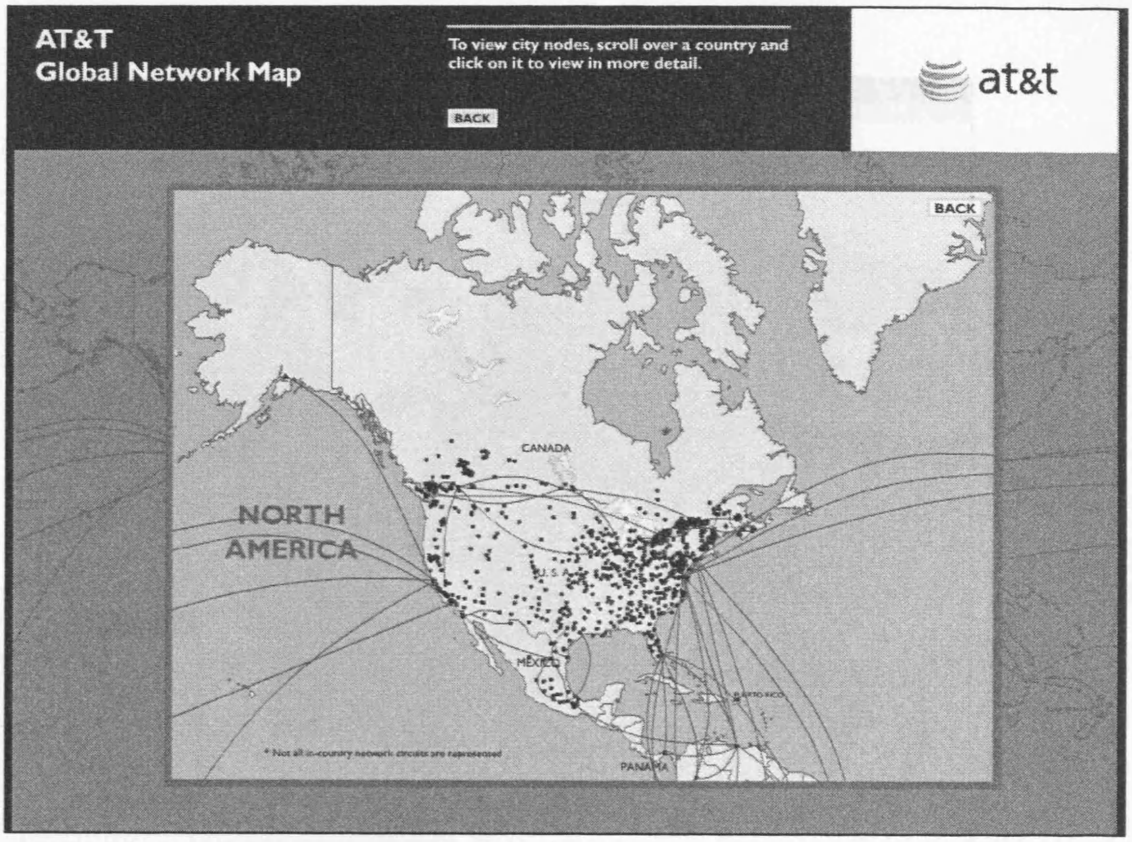
[1] Note, web addresses were correct at the time of the survey. Where multiple maps were available, for example for different regions or countries, only a representative example is shown here.

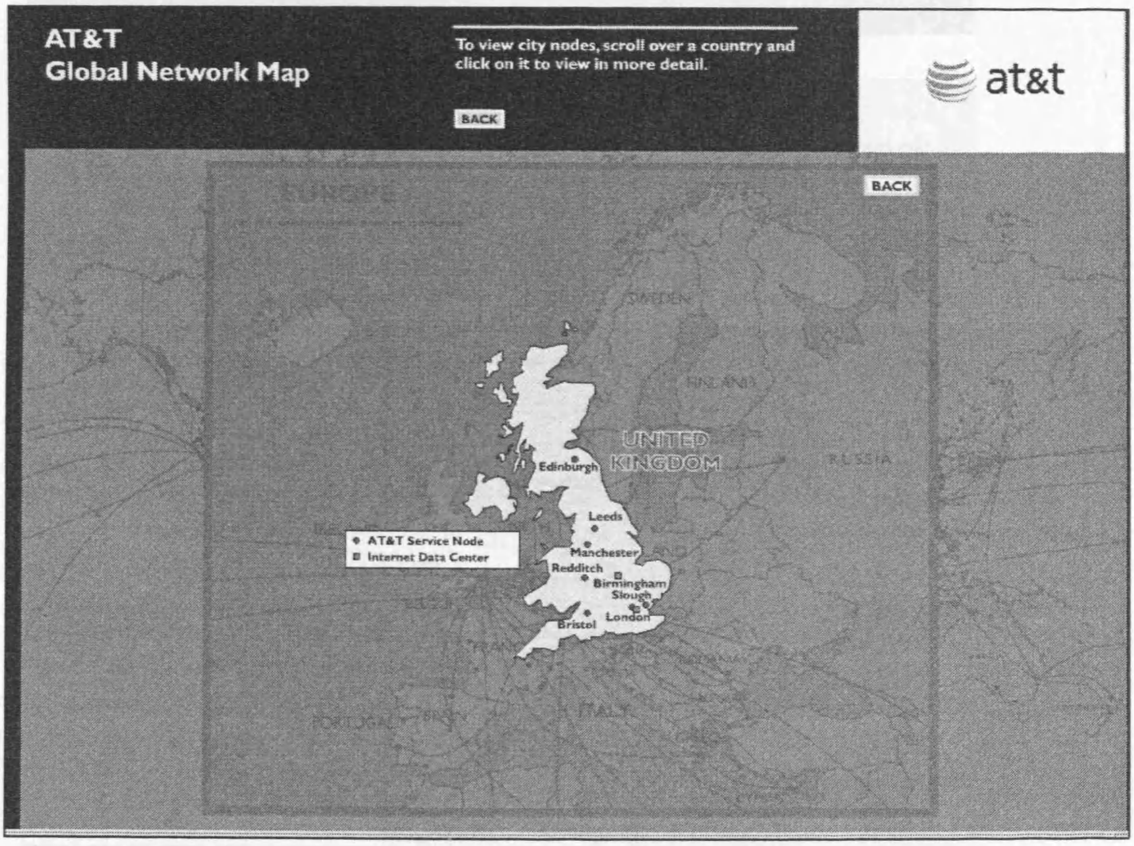
2. AT&T WorldNet (USA), <www.att.com>

Source: <www.corp.att.com/globalnetworking/media/network_map.swf>



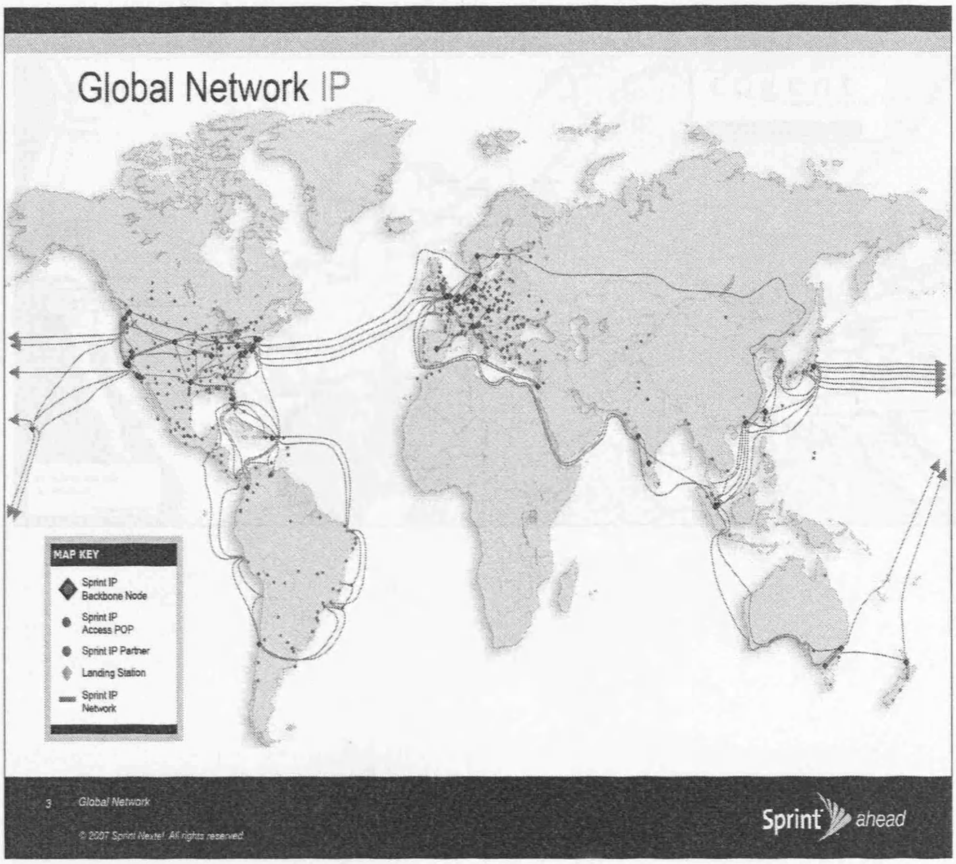


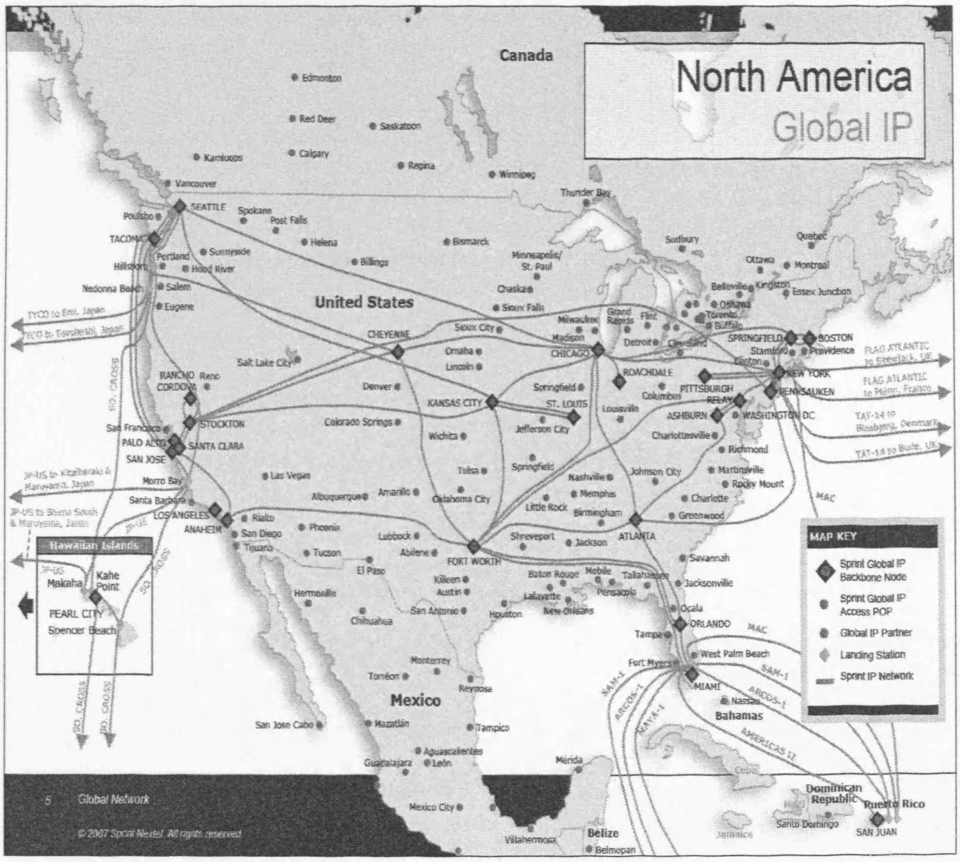

AT&T
Global Network Map
To view city nodes, scroll over a country and click on it to view in more detail.
BACK
at&t
BACK
CANADA
NORTH
AMERICA
U.S.A.
MEXICO
PANAMA


AT&T
Global Network Map
To view city nodes, scroll over a country and click on it to view in more detail.
BACK
at&t
BACK
SWEDEN
FINLAND
UNITED
KINGDOM
RUSSIA
Edinburgh
Leeds
Manchester
Redditch
Birmingham
Slough
Bristol
London
AT&T Service Node
Internet Data Center
PORTUGAL
ITALY

3. Sprint (USA), <www.sprint.net>

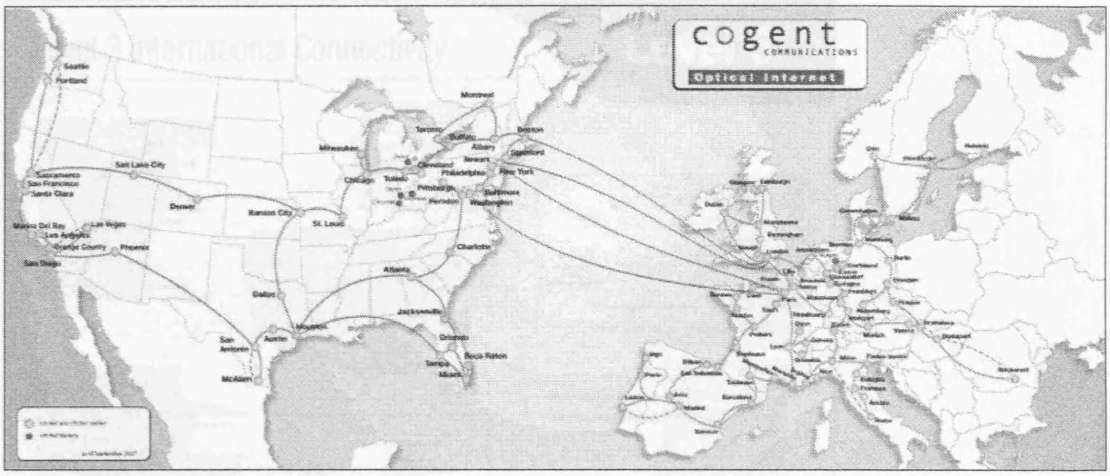
Source: <www.sprintworldwide.com/english/maps/index.html>





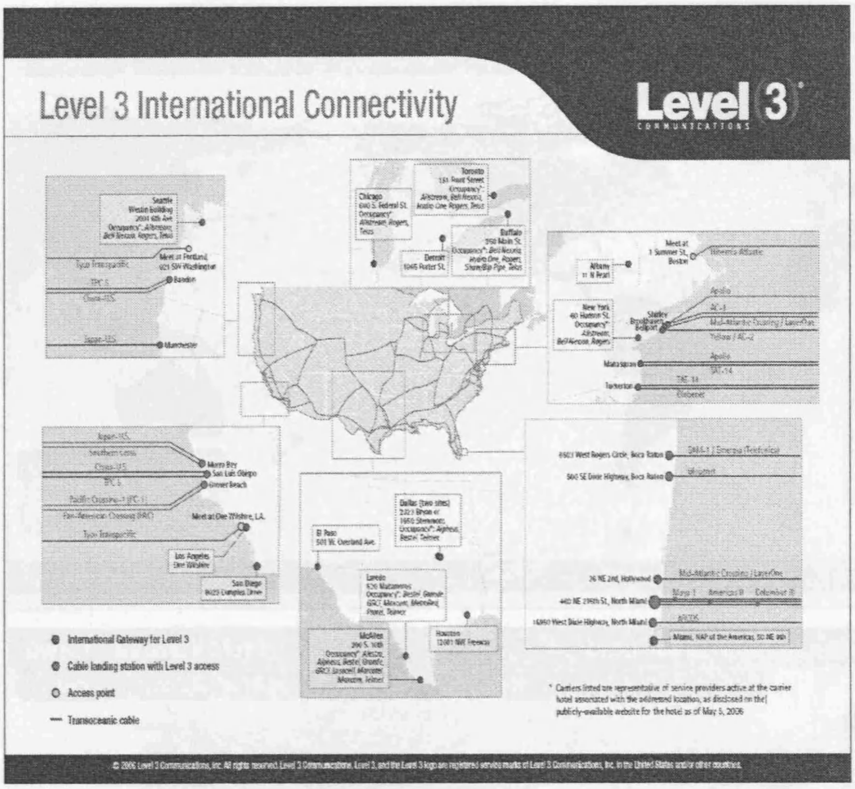
4. Cogent Communications (USA), <www.cogentco.com>

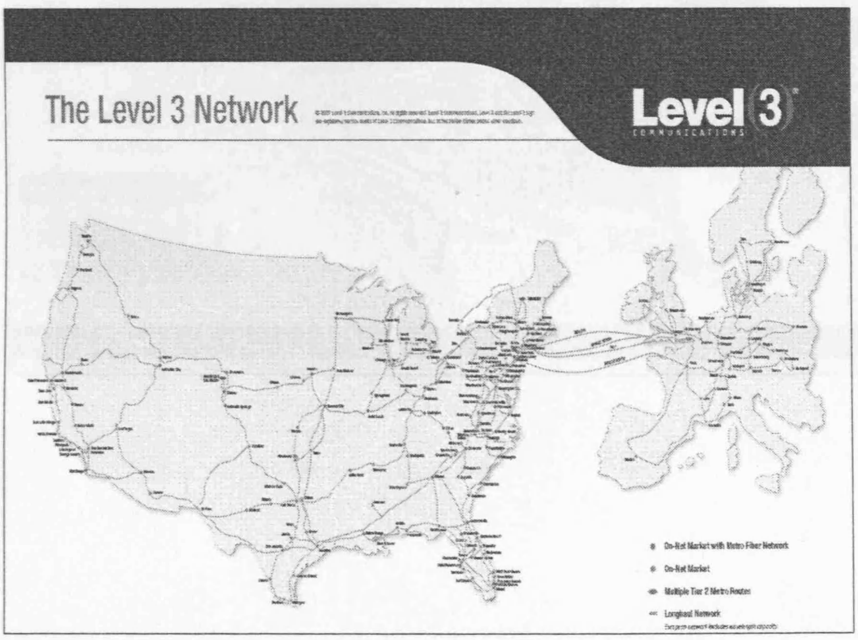
Source: <www.cogentco.com/htdocs/map.php>



5. Level 3 Communications (USA), <www.level3.com>

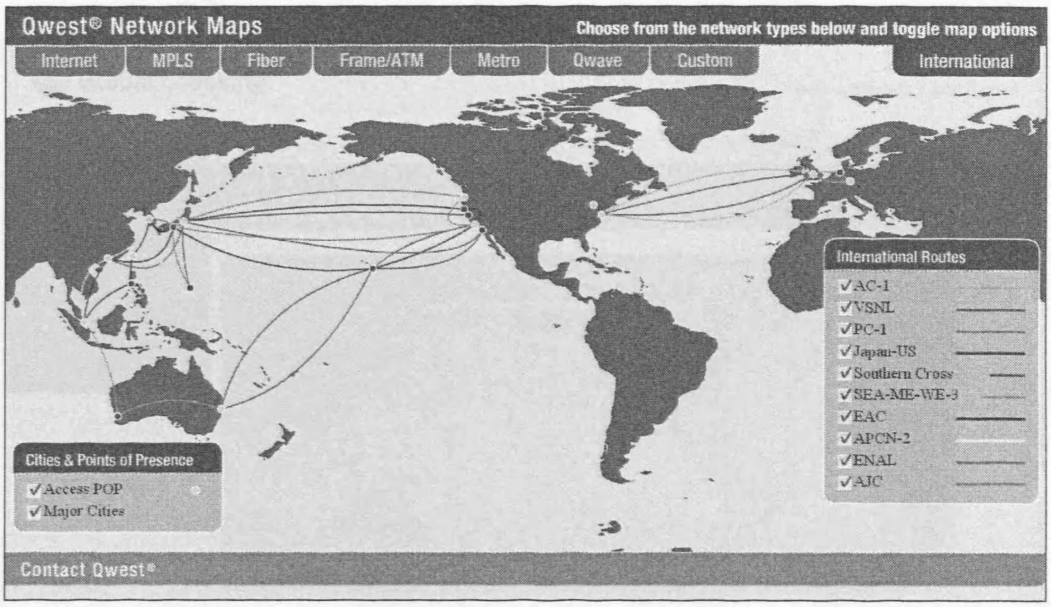
Source: <www.level3.com/about_us/aboutlevel3network/index.html>

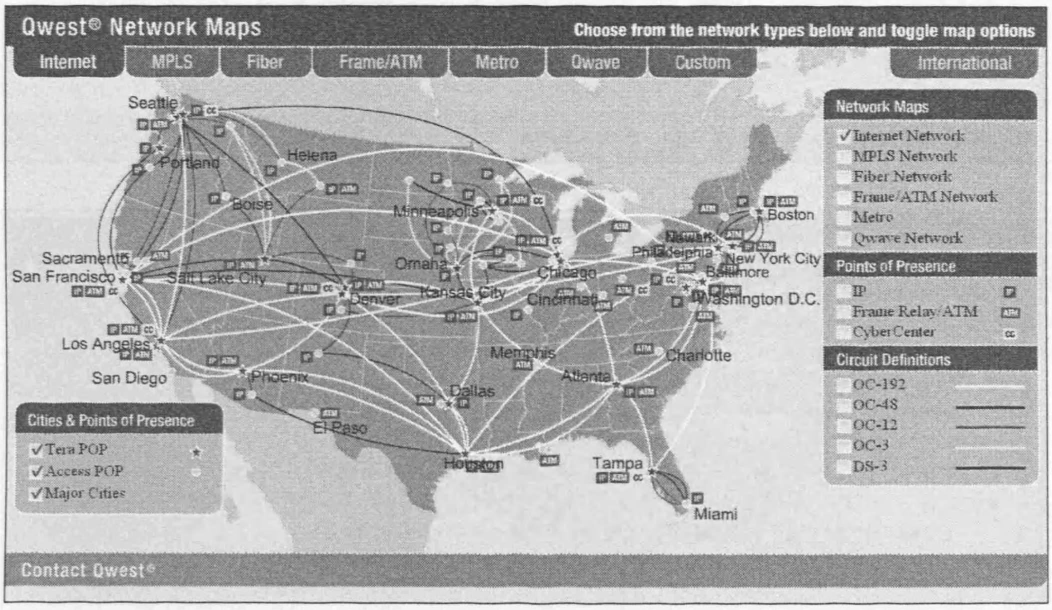




6. Qwest (USA), <www.qwest.com>

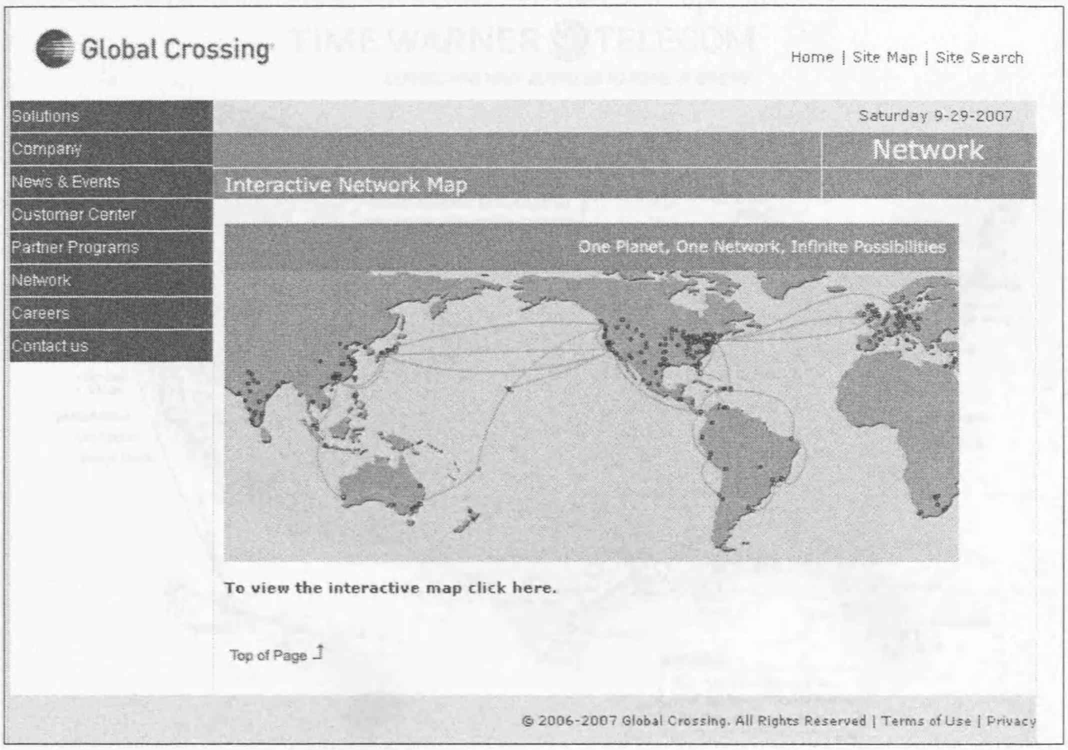
Source: <www.qwest.com/about/qwest/network/ ; http://stat.qwest.net/>

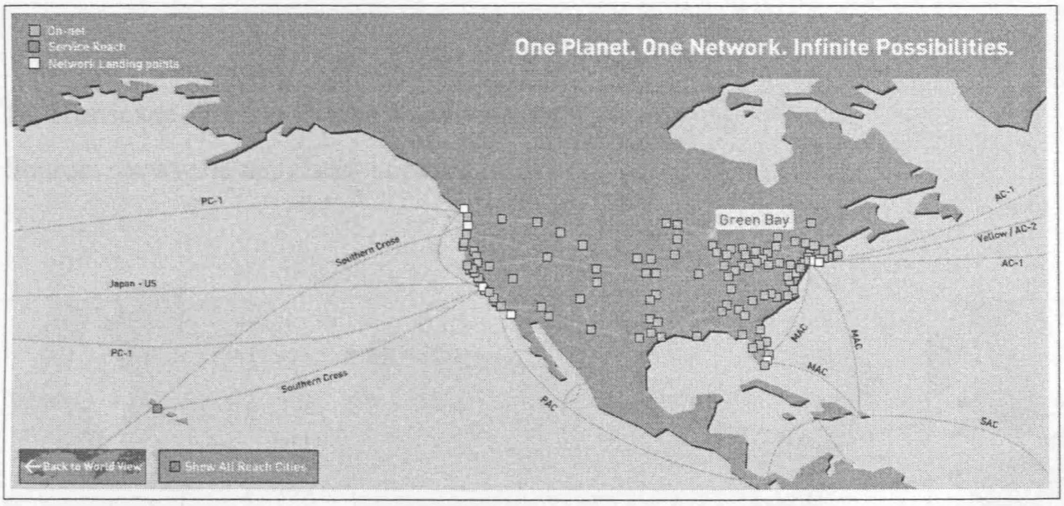




7. Global Crossing (USA), <www.globalcrossing.com>

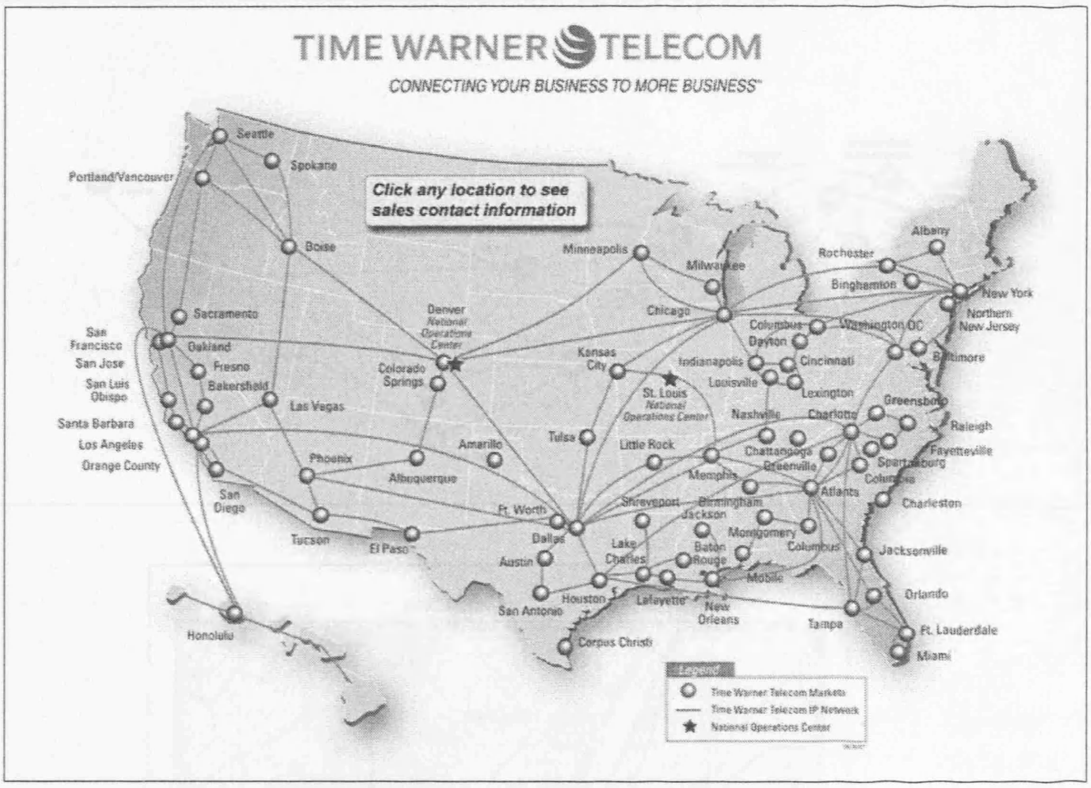
Source: <www.globalcrossing.com/network/network_interactive_map.aspx>





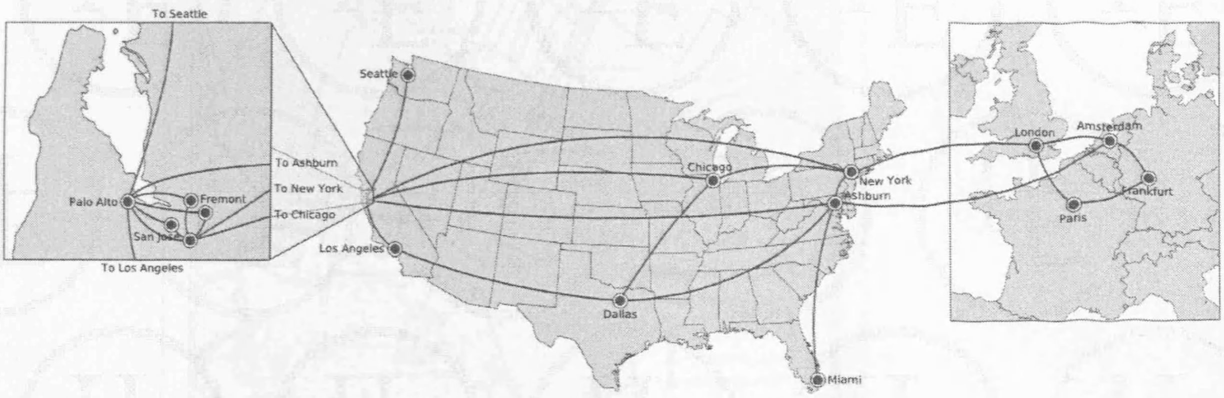
8. Time Warner Telecom (USA), <www.twtelecom.com>

Source: <www.twtelecom.com/about_us/networks.html>



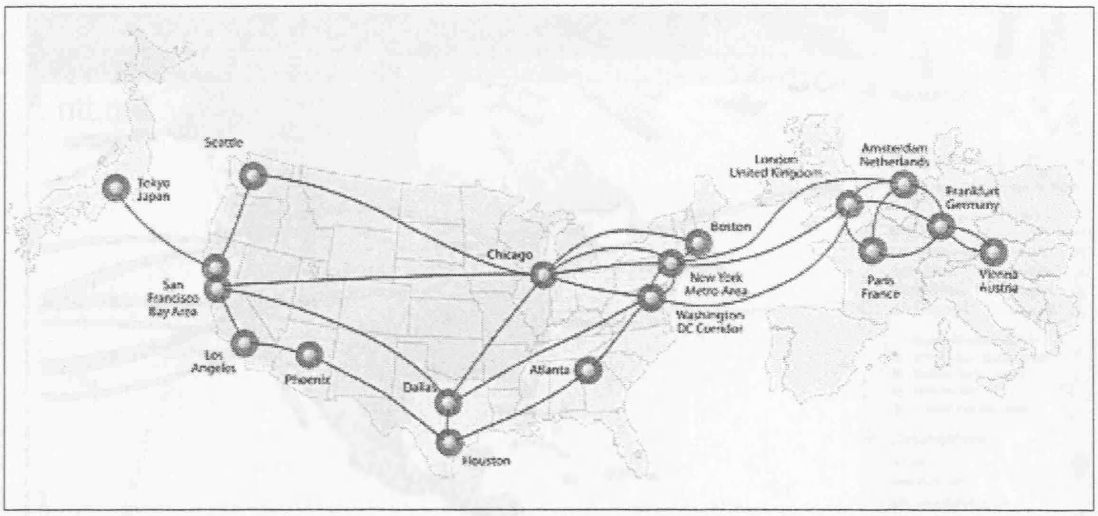
10. Hurricane Electric (USA), <www.he.net>

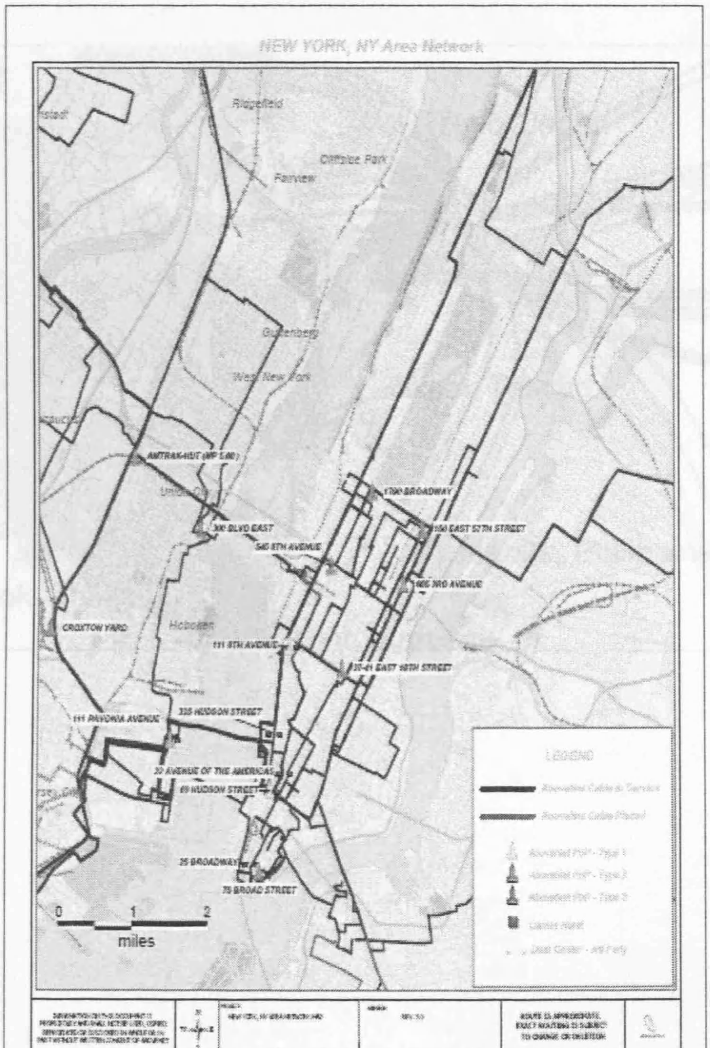
Source: <www.he.net/about_network.html>



11. Abovenet Communications (USA), <www.above.net>

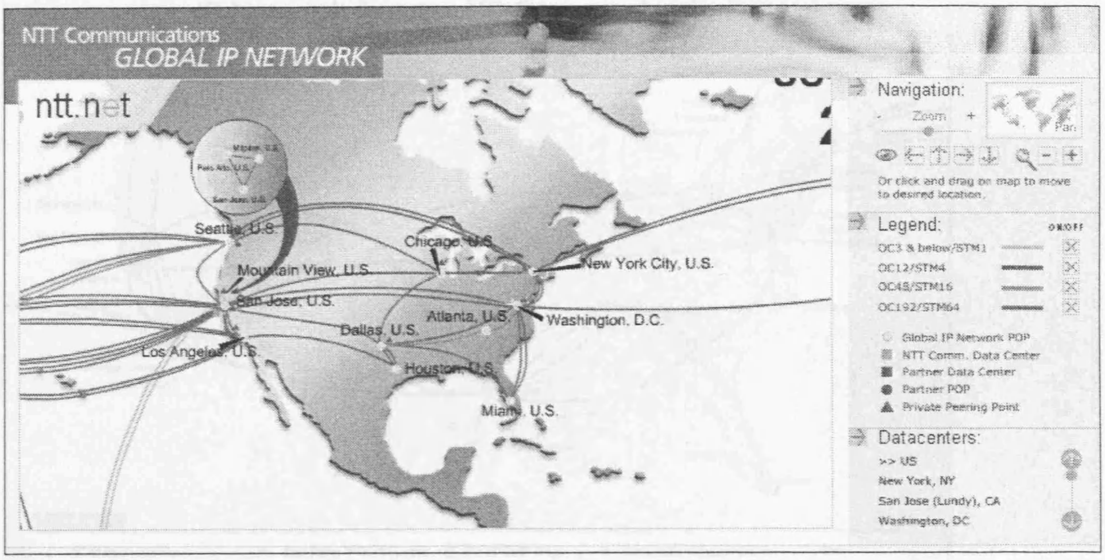
Source: <www.above.net/products/maps.html>

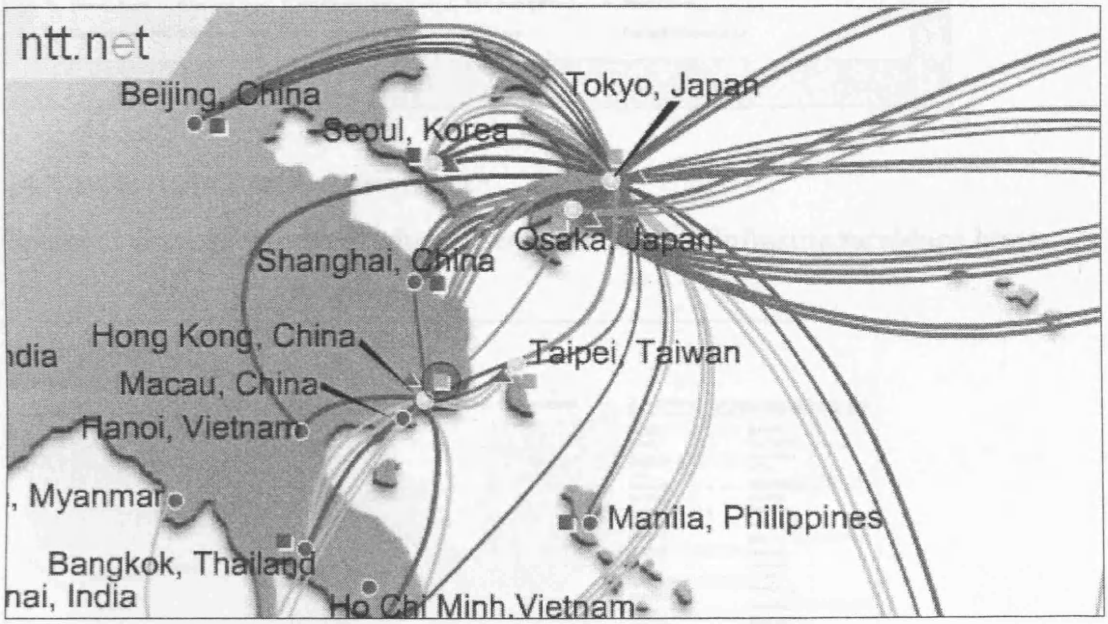




12. Verio (USA), <www.verio.com>

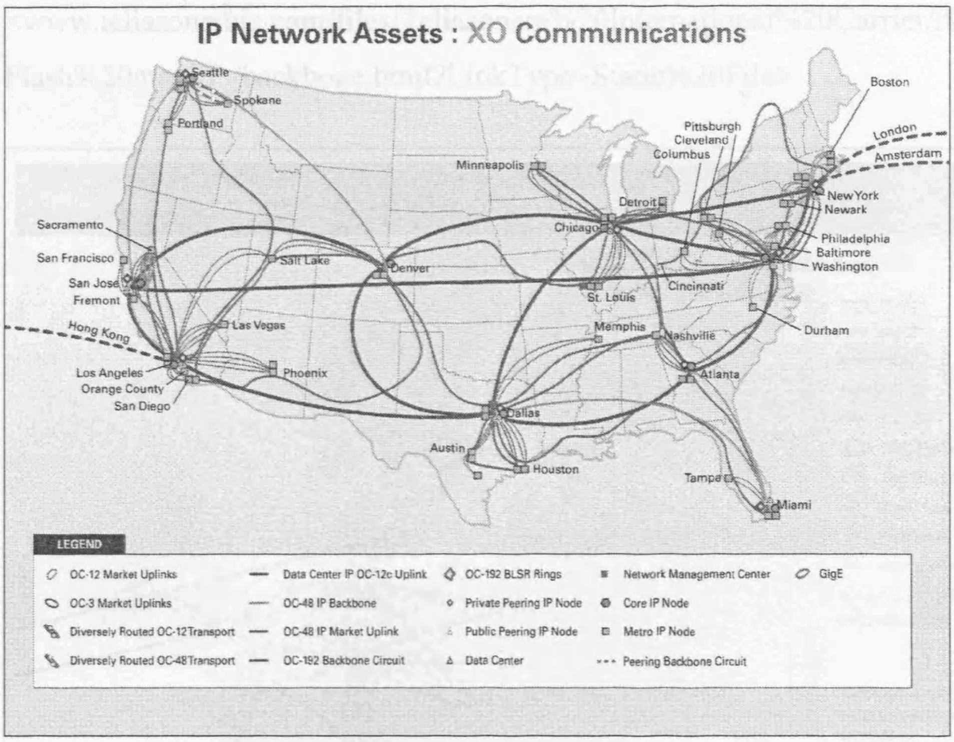
Source: <www.verio.com/about/network/gin.cfm>





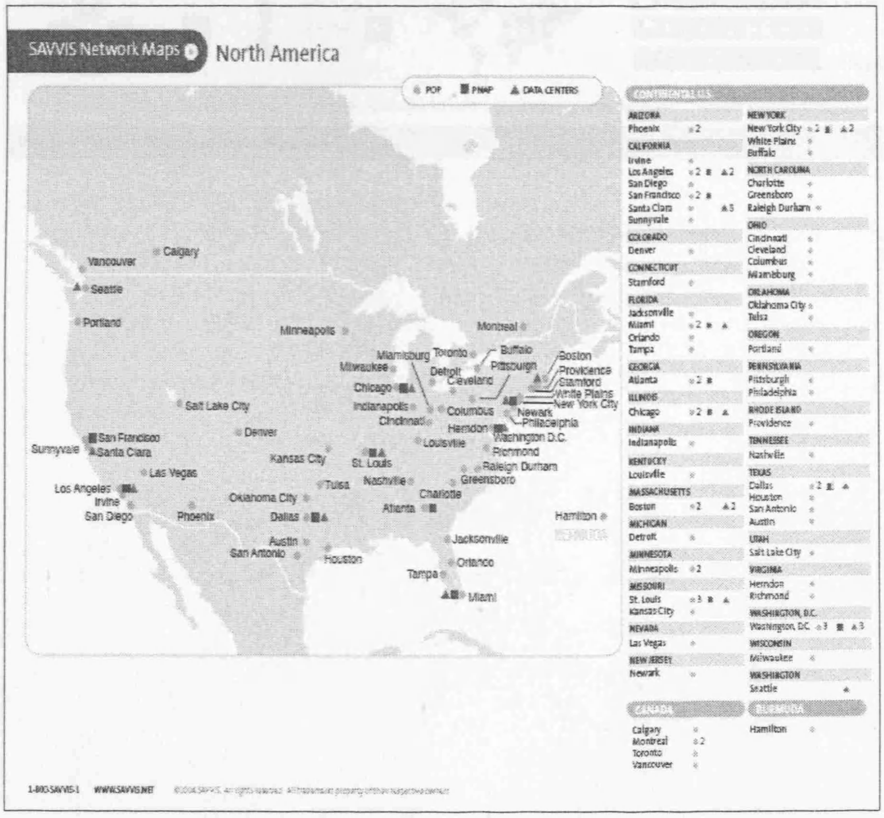
13. XO Communications (USA), <www.xo.com>

Source: <www.xo.com/about/network/maps.html>



14. Savvis (USA), <www.savvis.net>

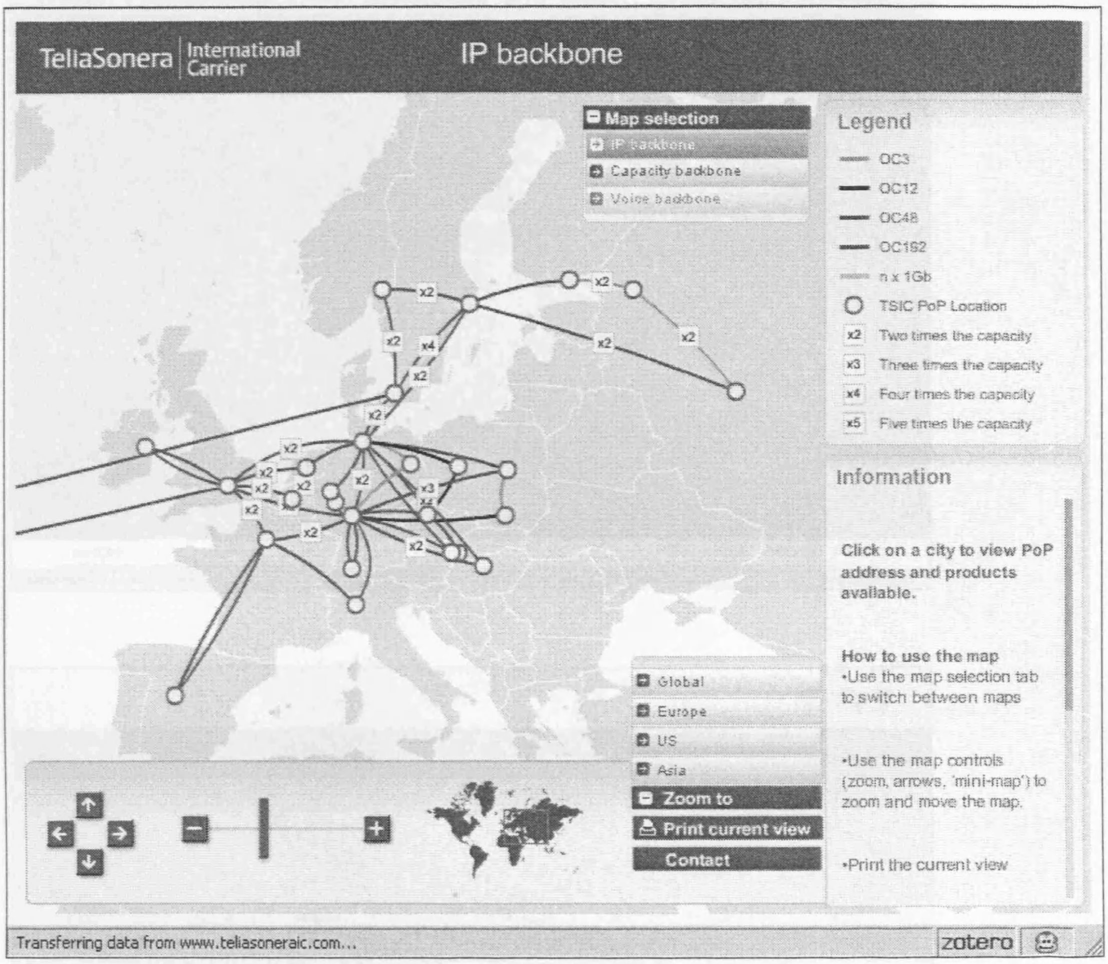
Source: <www.savvis.net/Products+Services/Network/InfrastructureMaps.htm>



15. TeliaSonera (SE), <www.teliasoneraic.com>

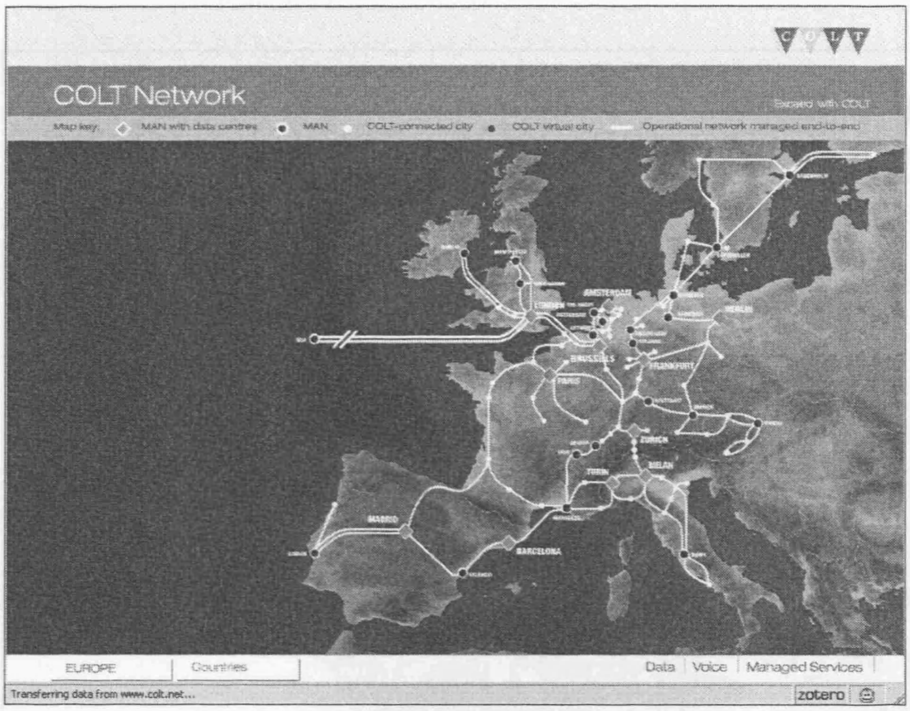
Source:

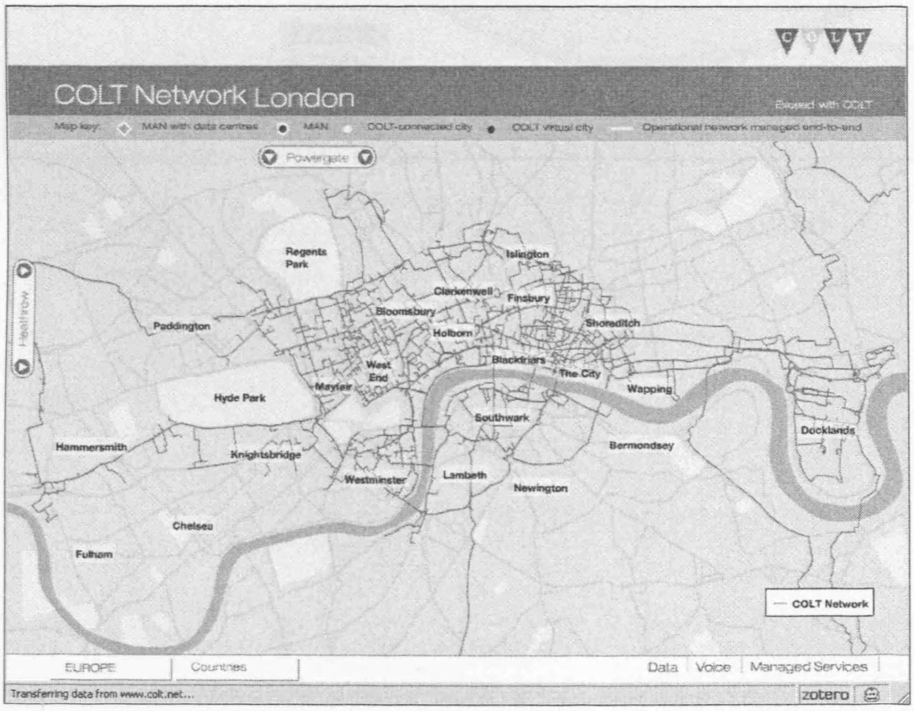
<www.teliasoneraic.com/files/Teliasonera%20International%20Carrier/Articles/Flash%20map/IP_backbone.html?LinkType=Static%20File>



16. COLT Telecommunications (NL), <www.colt.net>

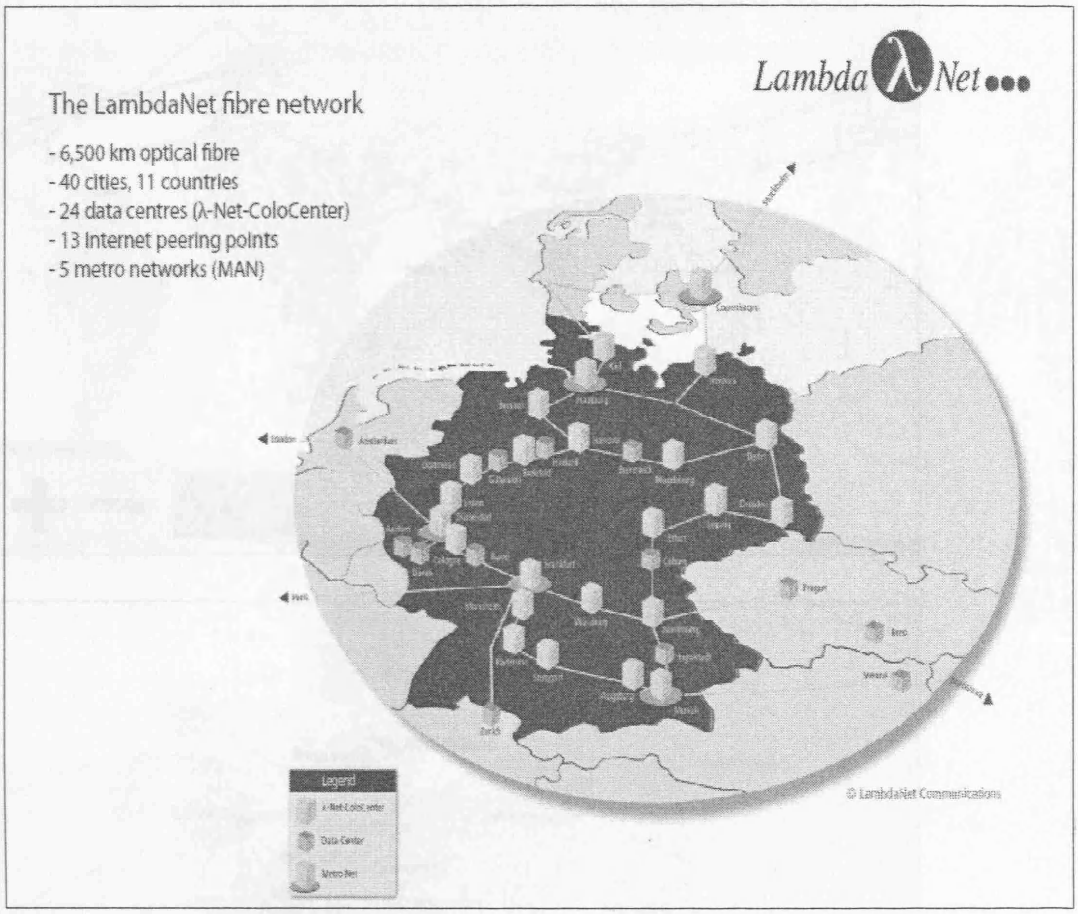
Source: <www.colt.net/uk/en/about_colt>





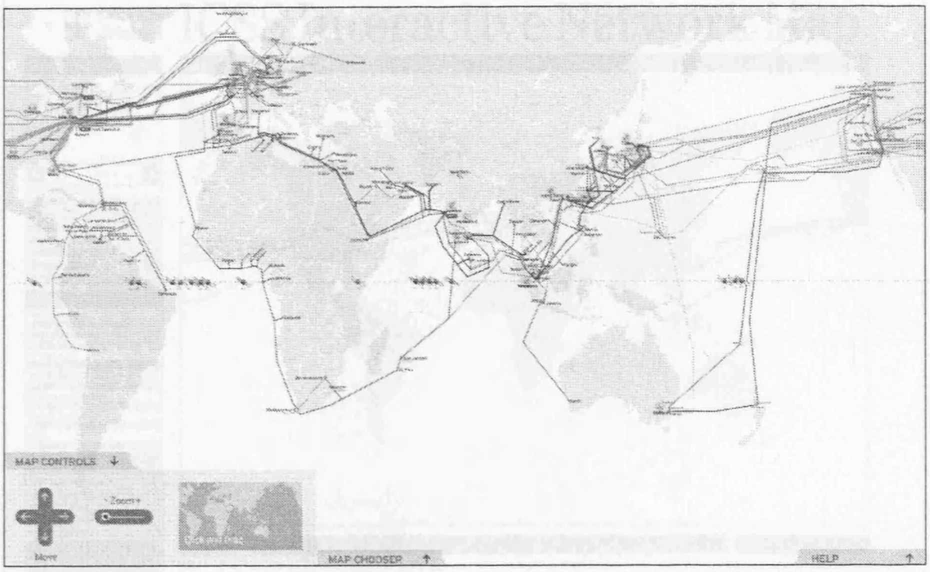
17. LambdaNet (DE), <www.lambdanet.net>

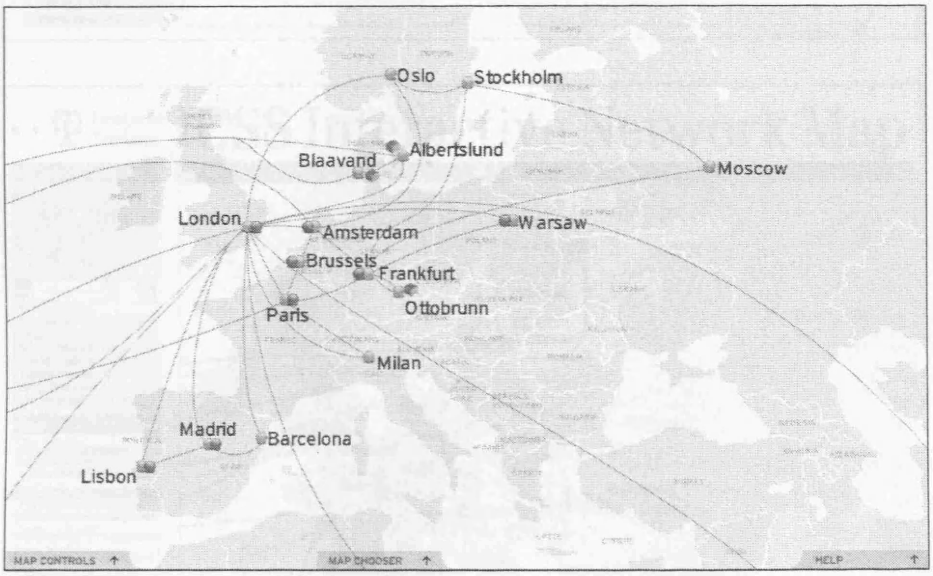
Source: <www.lambdanet.net/userfiles/netzgrafiken/lambdanet-netzwerk-e.pdf>



18. VSNL International (CA), <www.vsnlinternational.com>

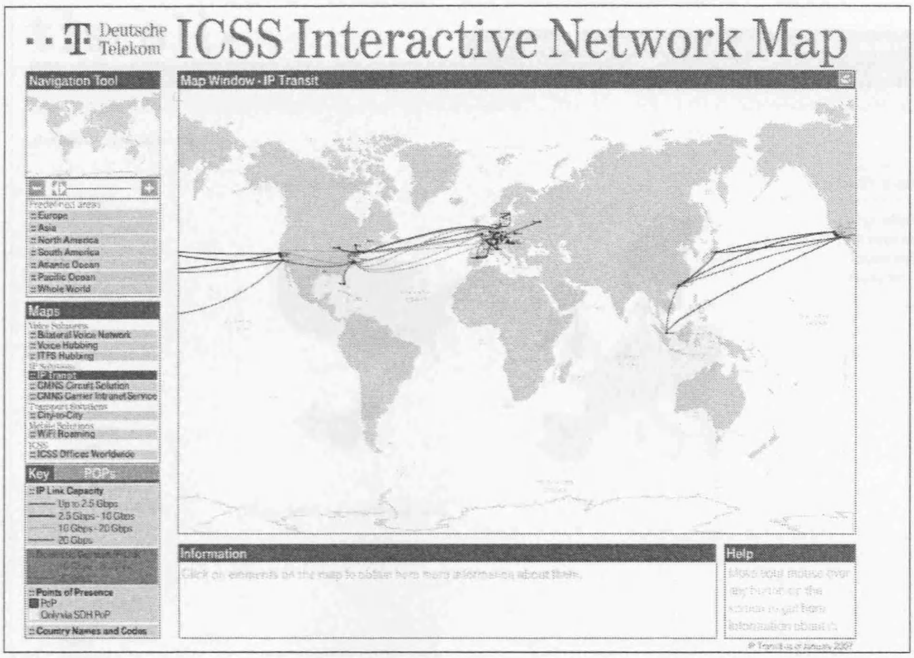
Source: <www.vsnlinternational.com/map/>

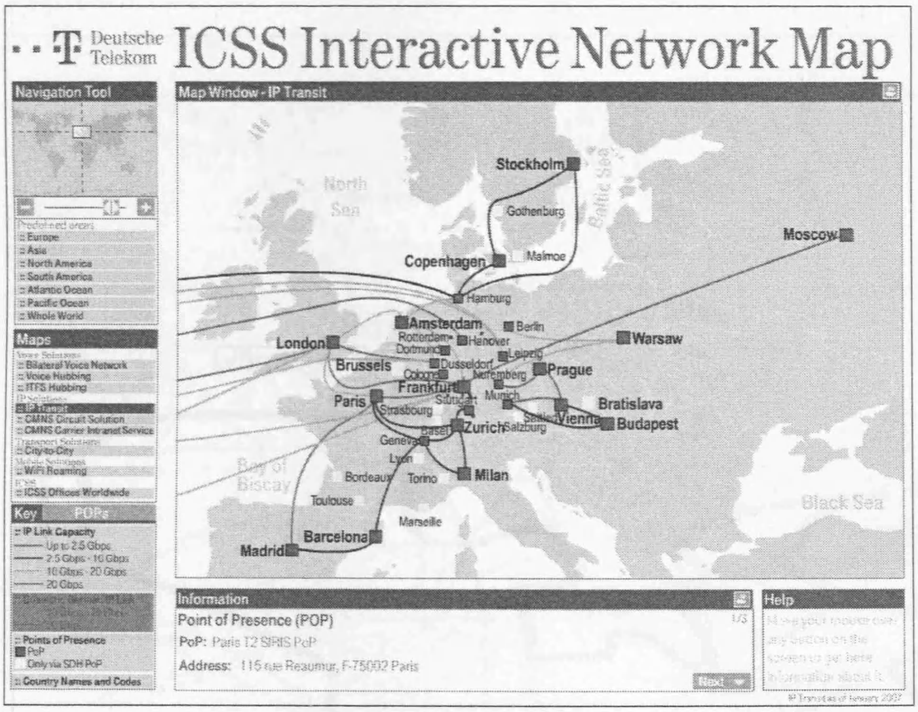




19. Deutsche Telekom (DE), <www.deutschetelekom.com>

Source: <www.deutschetelekom.com/dtag/cms/content/ICSS/en/216802>



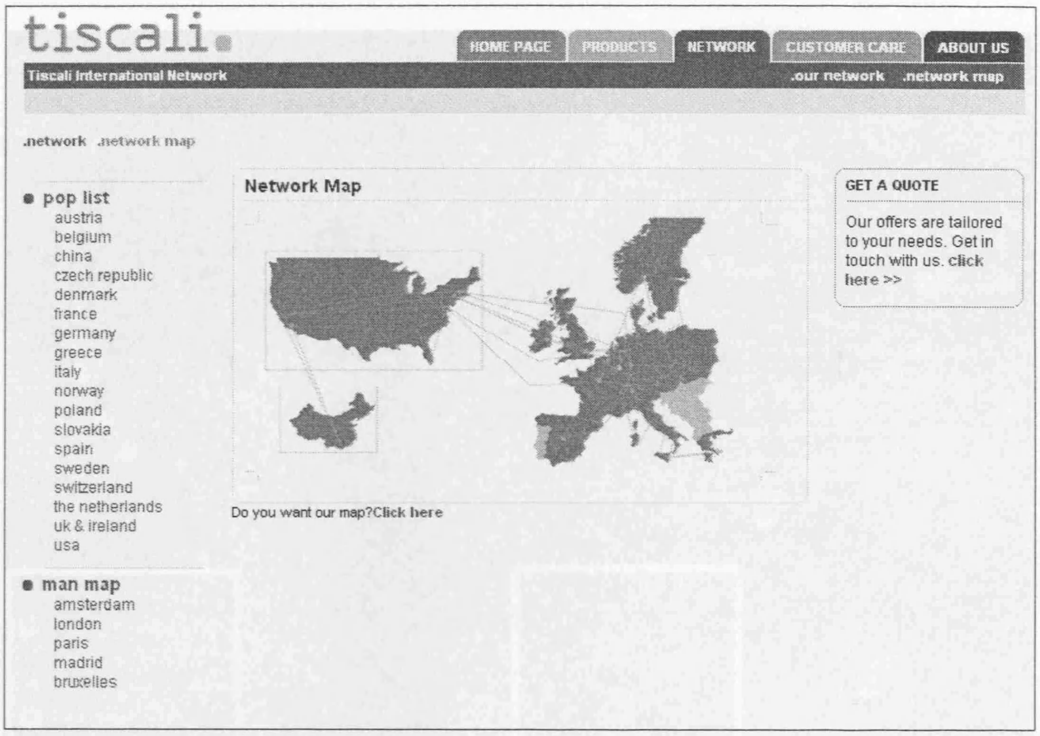


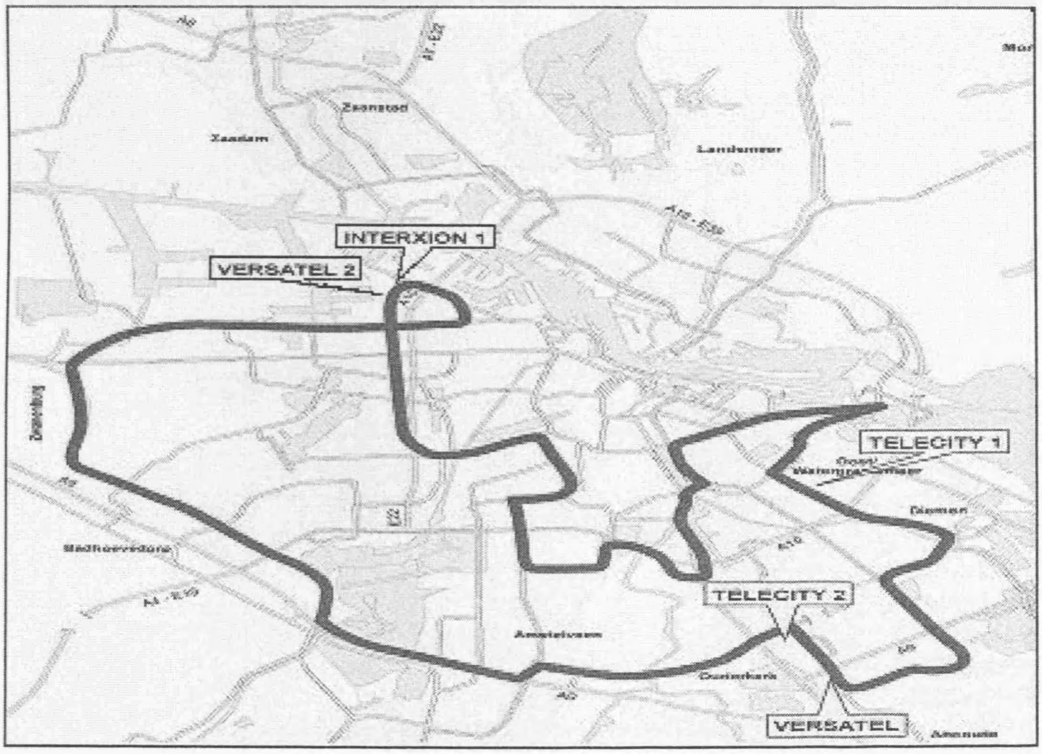
20. Swisscom (CH), <www.swisscom.com>

No maps found.

21. Tiscali International Network (DE), <www.tiscali.net>

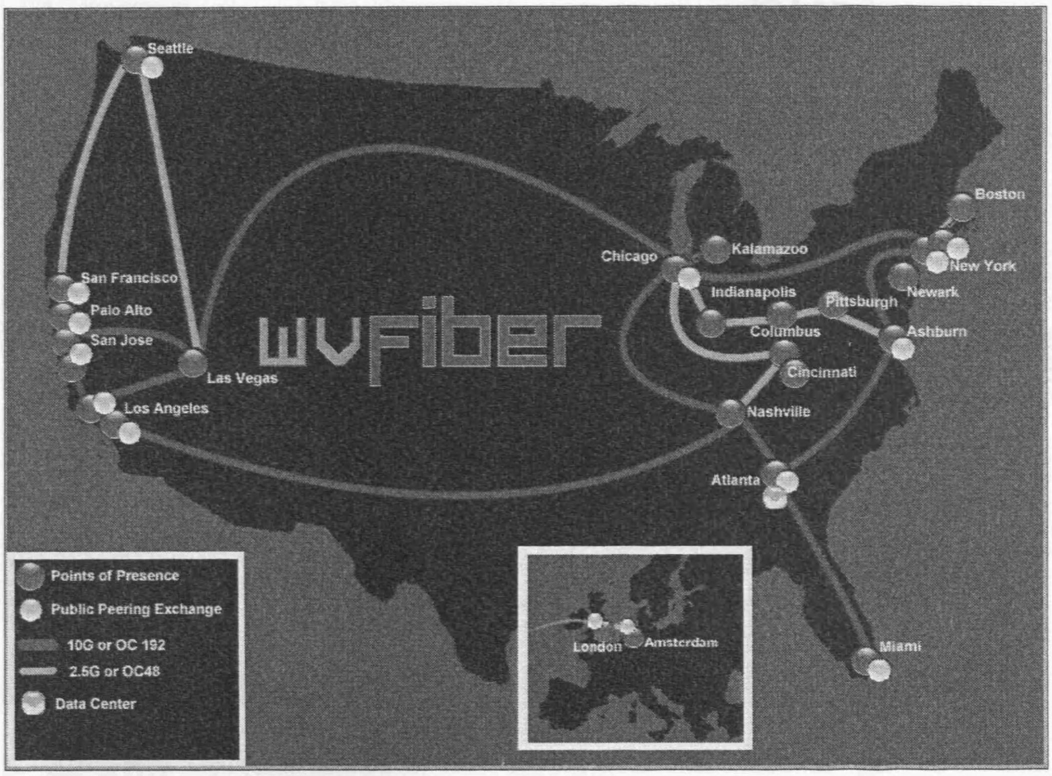
Source: <www.tiscali.net/index.php?a=b&id=101&p=network_map>





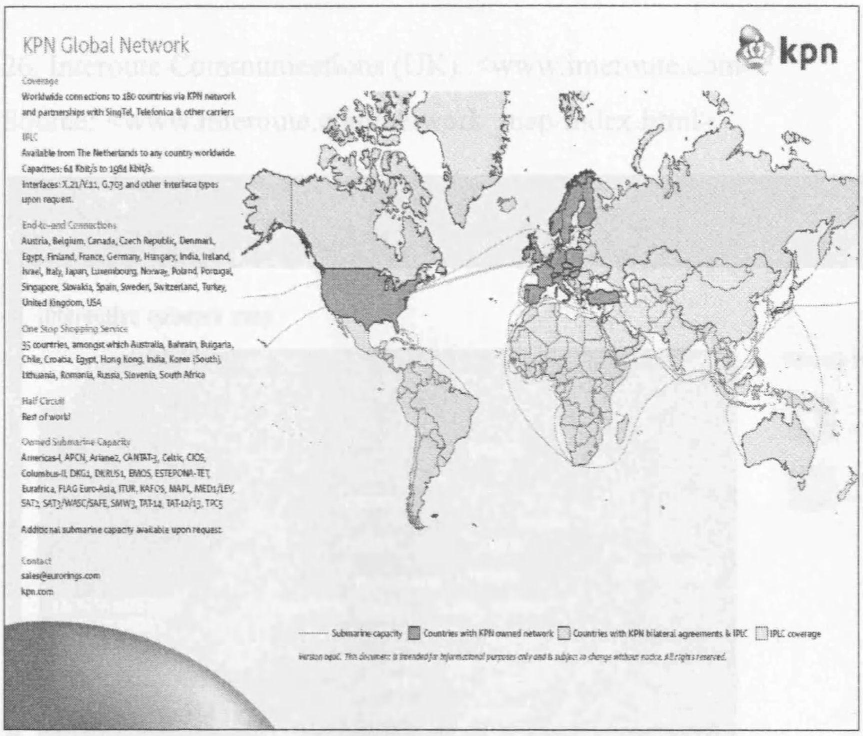
23. WV Fiber (USA), <www.wvfiber.com>

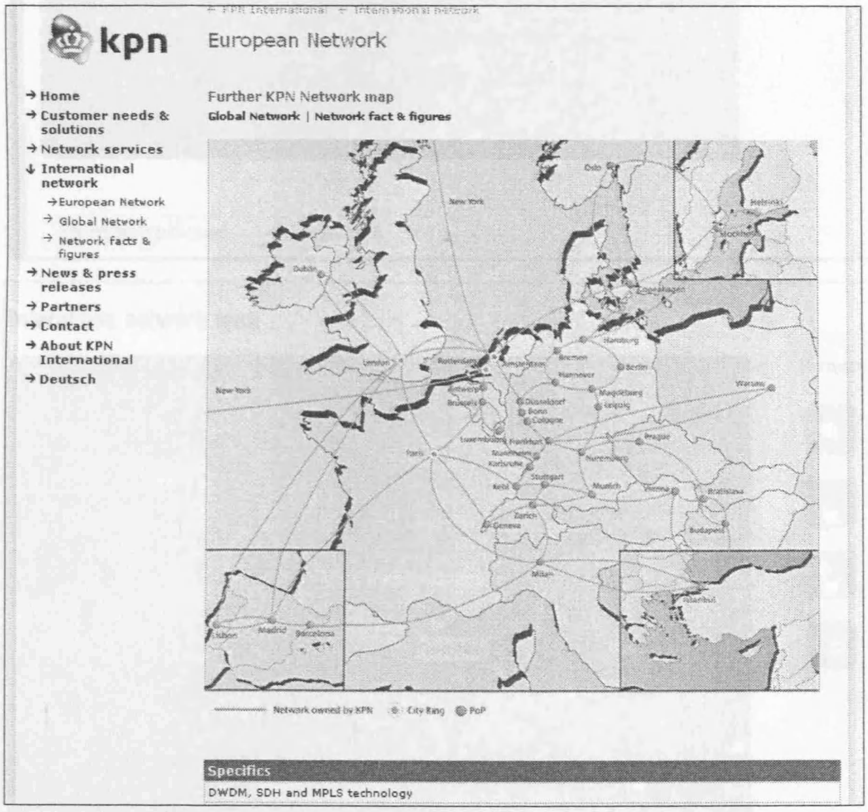
Source: <www.wvfiber.com/netmapus.htm>



24. KPN (NL), <www.kpn.com>

Source: <www.kpn.com/kpn/show/id=1228594>



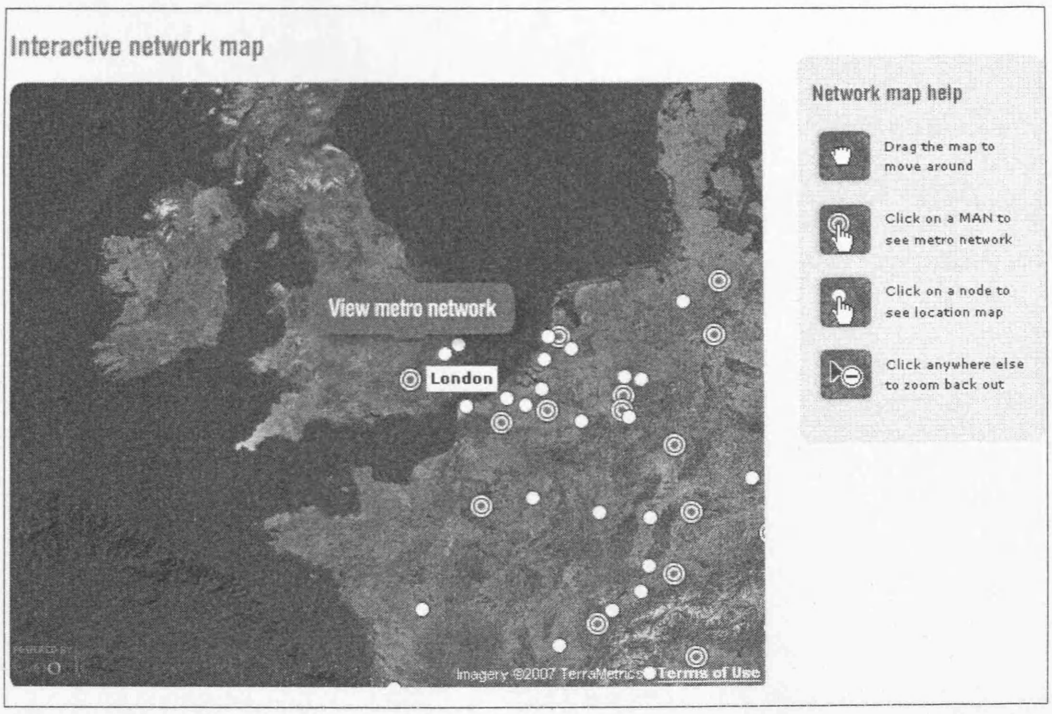


25. LG DACOM (KR), <www.lgdacom.net>

No maps found.

26. Interoute Communications (UK), <www.interoute.com>

Source: <www.interoute.com/network_map/index.html>



27. Korea Telecom (KR), <www.kt.co.kr>

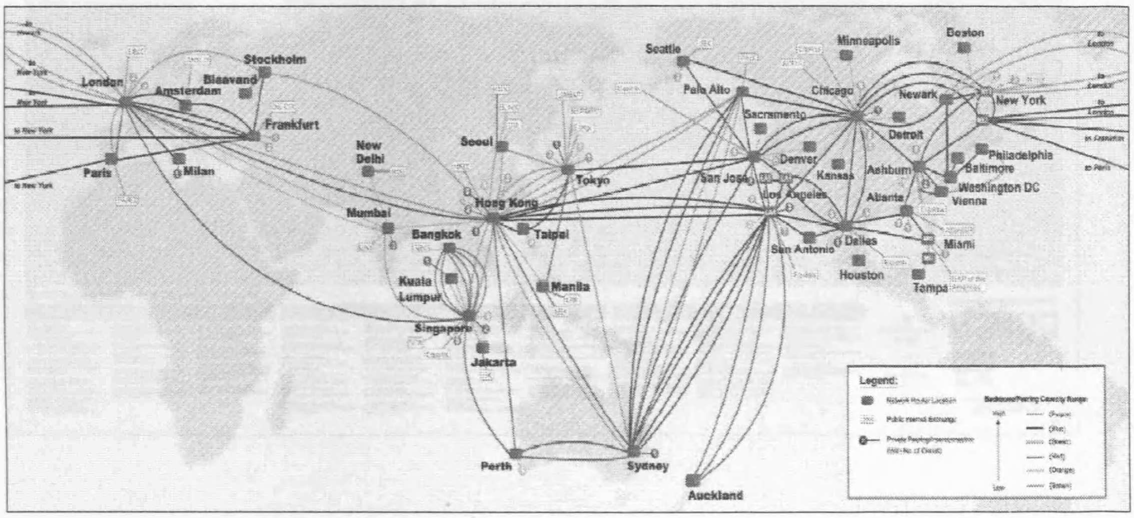
No maps found.

28. Bell Canada (CA), <www.bell.ca>

No maps found.

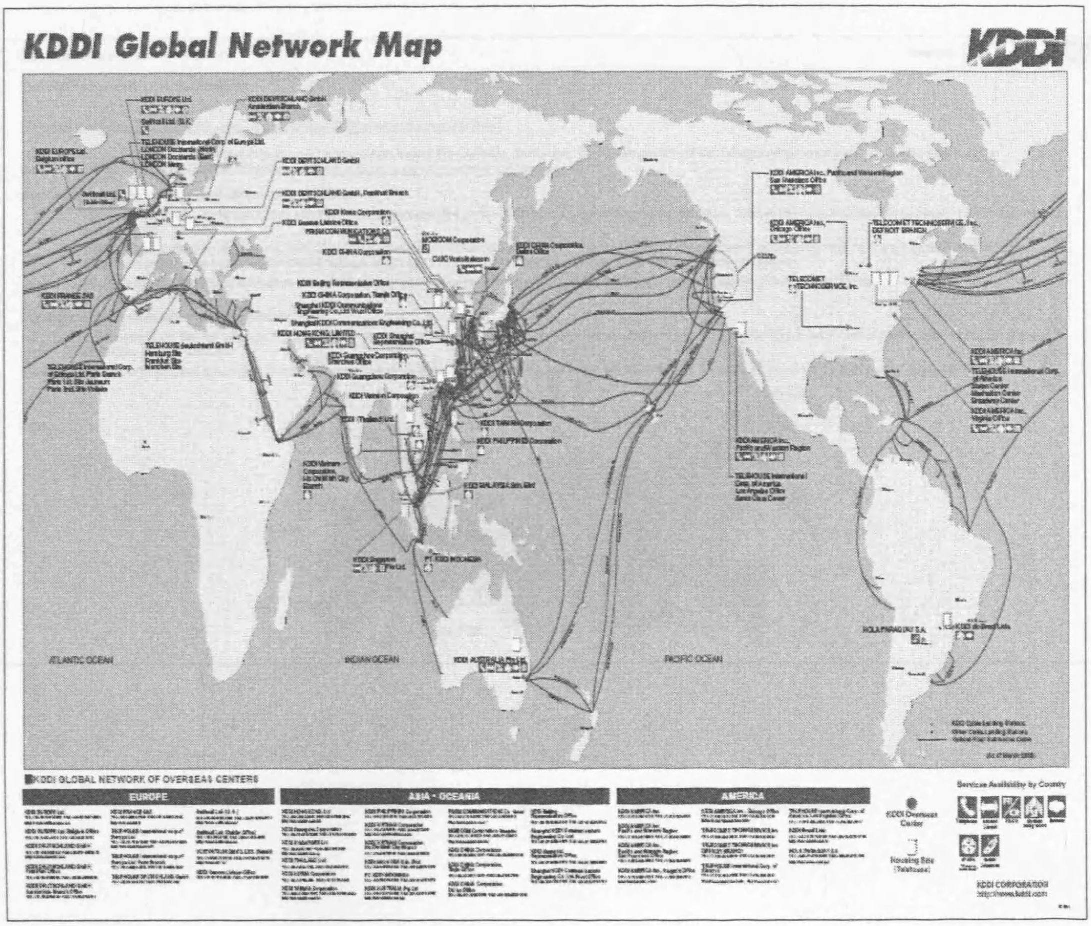
29. PCCW (USA), <www.pccwglobal.com>

Source: <www.pccwglobal.com/network-technology/ip-coverage.php>



30. KDDI Corporation (JP), <www.kddi.com>

Source: <www.kddi.com/english/business/oversea/index.html>



31. TransTeleCom (RU), <www.transtk.ru>

Source: <www.transtk.ru/www/nsf/esite.nsf/docs/dwdm.html>

Main Page :: Network :: DWDM Network

Search:

The DWDM Network of TransTeleCom

The DWDM technology increases the capacity of fiber optic backbones by hundreds of times.

TransTeleCom began to implement the DWDM technology in all the main lines of the backbone. In the near future, the capacity of the network will grow considerably for the most popular telecommunication routes, which will allow TransTeleCom to completely satisfy the requirements of all clients.

The construction of the DWDM network consists of three phases:

- **Phase 1** was finished in the early 2005 with the DWDM system installed on the 8700-km-long route through Kamennogorsk, Saint Petersburg, Moscow, Ekaterinburg, Novosibirsk, Irkutsk, and Zabaikalsk.
- **Phase 2** was finished on the July 1st, 2005. TransTeleCom started commercial exploitation of the line between Kamennogorsk (Leningradsky region) and Karymsky (Chita region). Completion of this stage increased the DWDM network length up to 12 700 km and provided redundancy for the most important routes.
- **Phase 3** was finished on the November 15th, 2005. This stage ensured the full redundancy of the DWDM network. Its total length reached 18 925 km.

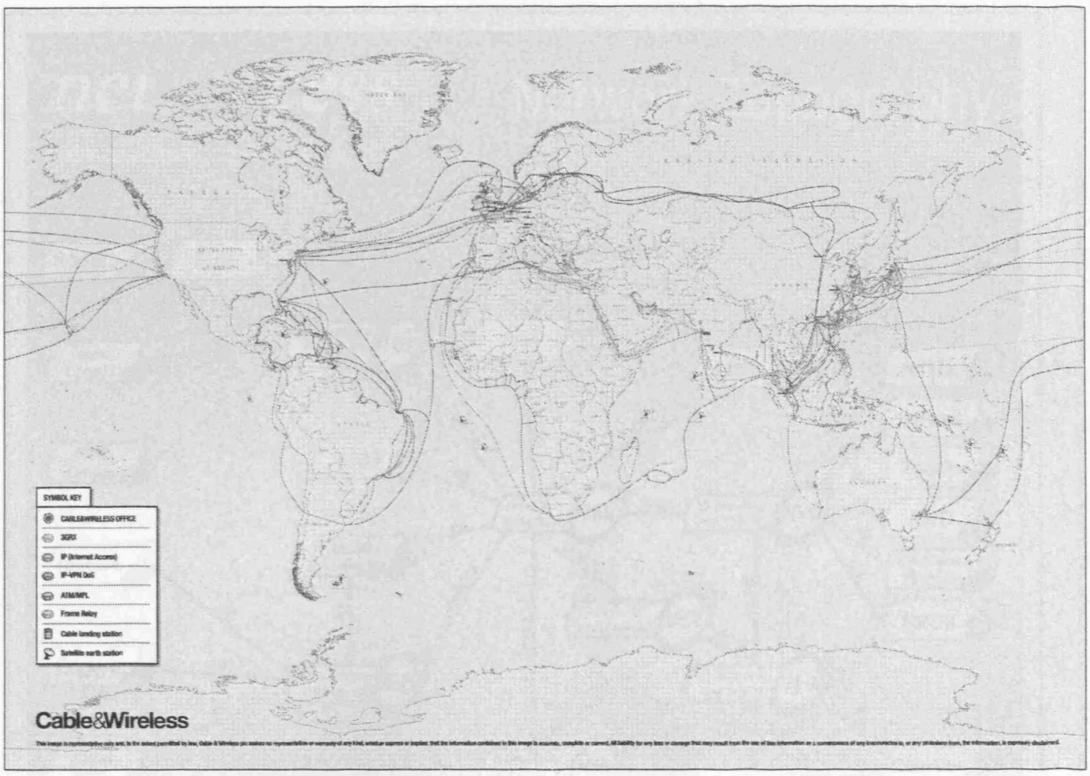
TransTeleCom continuously develops the DWDM network:

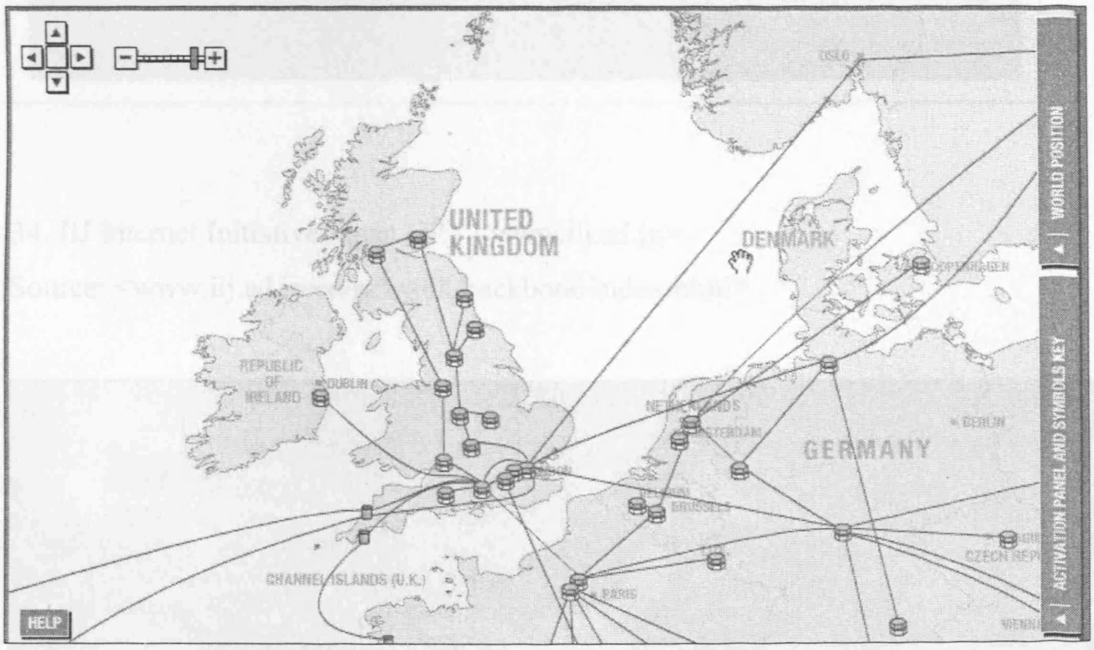
- In February 2006, the line between Moscow - Kursk - Voronej - Rostov-na-Donu - Volgograd - Saratov - Syzran - Samara, so called "South way", was put into work. The length of the new DWDM line reaches 3500 km.

TransTeleCom started working out the project to increase network capacity in the Far East region: to construct the 2 200 km long DWDM line between BAM station and Vladivostok.

32. Cable & Wireless (UK), <www.cw.com>

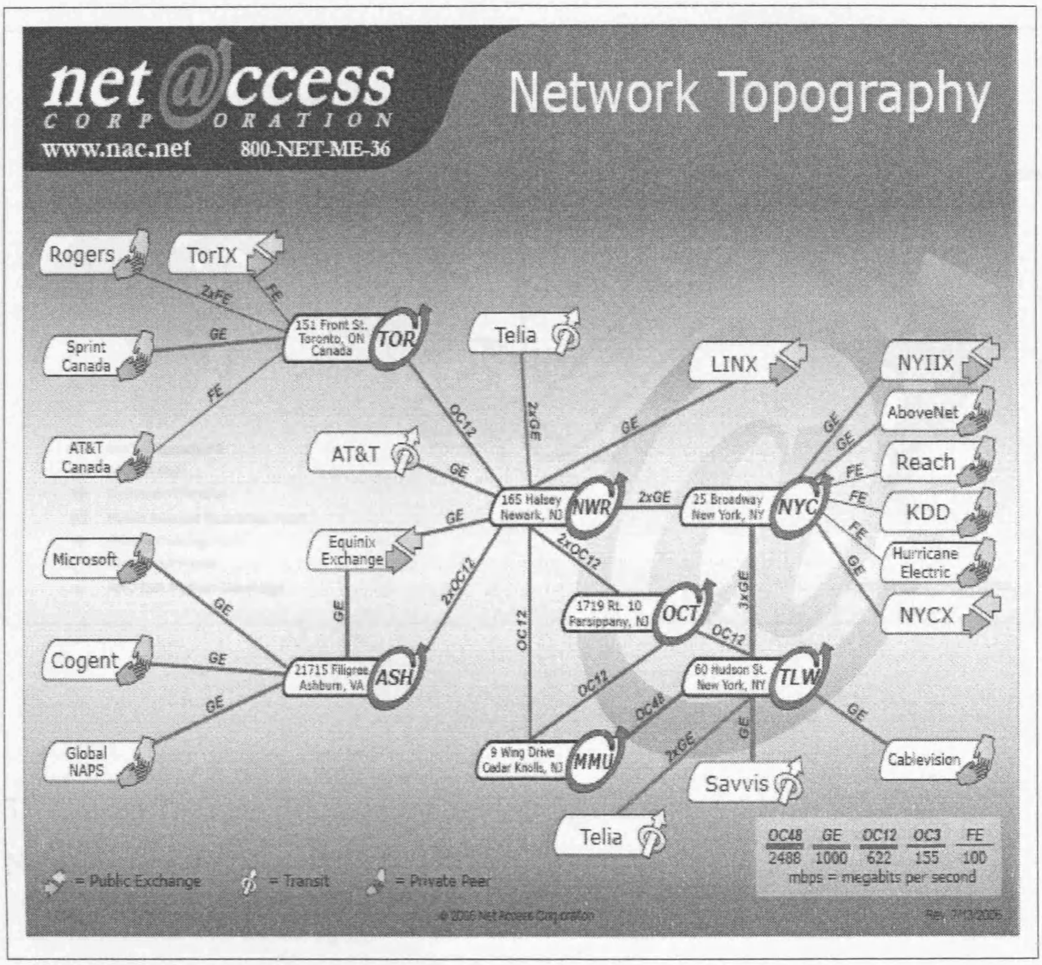
Source: <http://portal.cw.com/wps/portal/internet/UK/GlobalView>





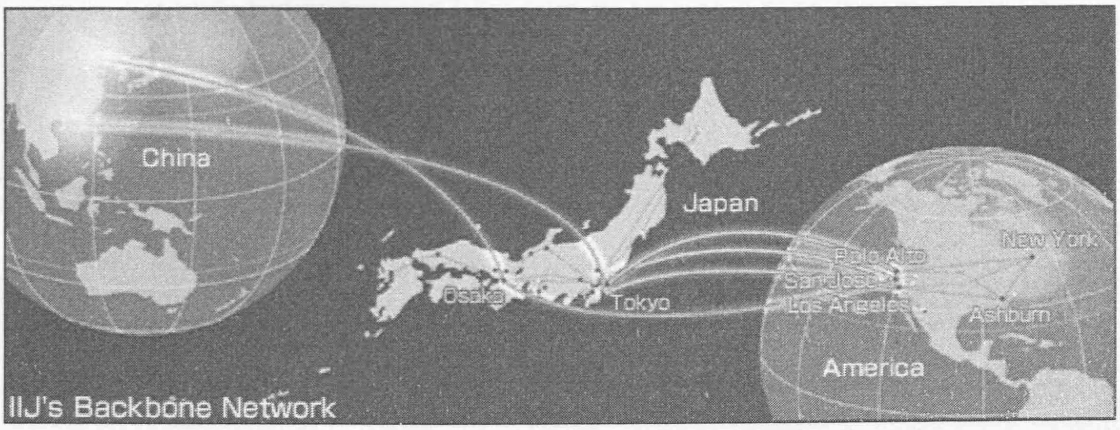
33. Net Access Corporation (USA), <www.nac.net>

Source: <www.nac.net/enterprise/dedicated.asp?page=NetMap>



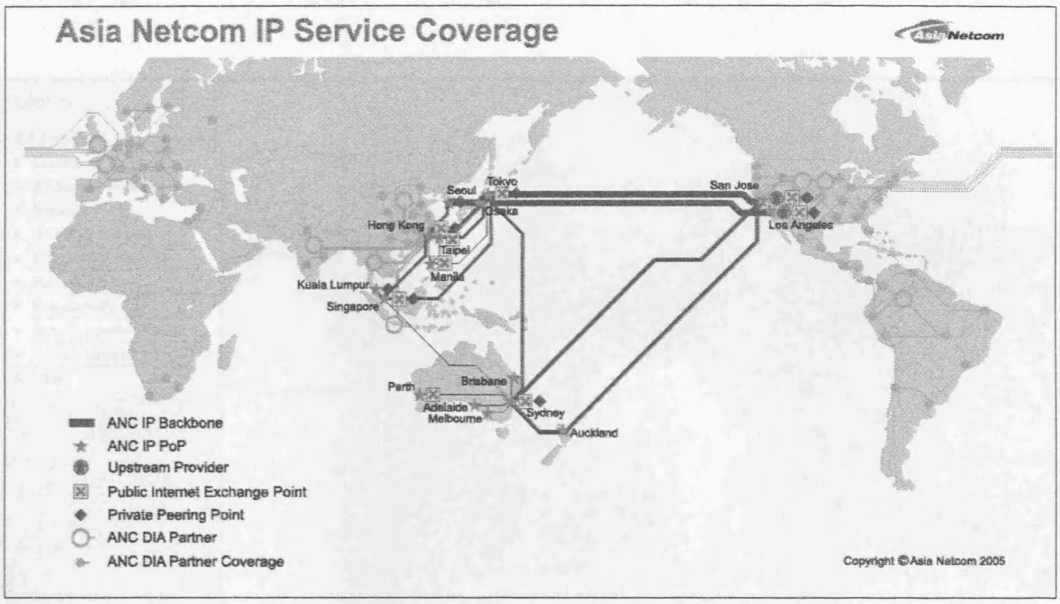
34. IIJ Internet Initiative Japan (JP), <www.iij.ad.jp>

Source: <www.iij.ad.jp/en/network/backbone/index.html>



35. Asia Netcom (CN), <www.asianetcom.com>

Source: <www.asianetcom.com/inter/index.asp?pg=network_infrastructure>



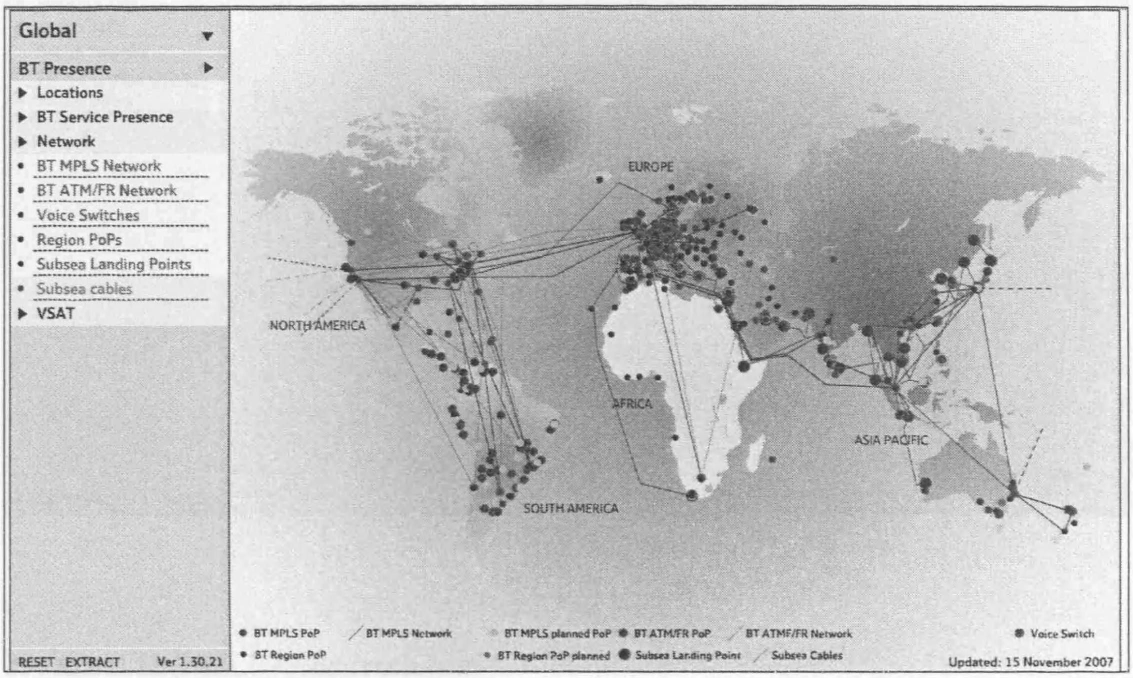
37. Golden Telecom (RU), <www.goldentelecom.ru>

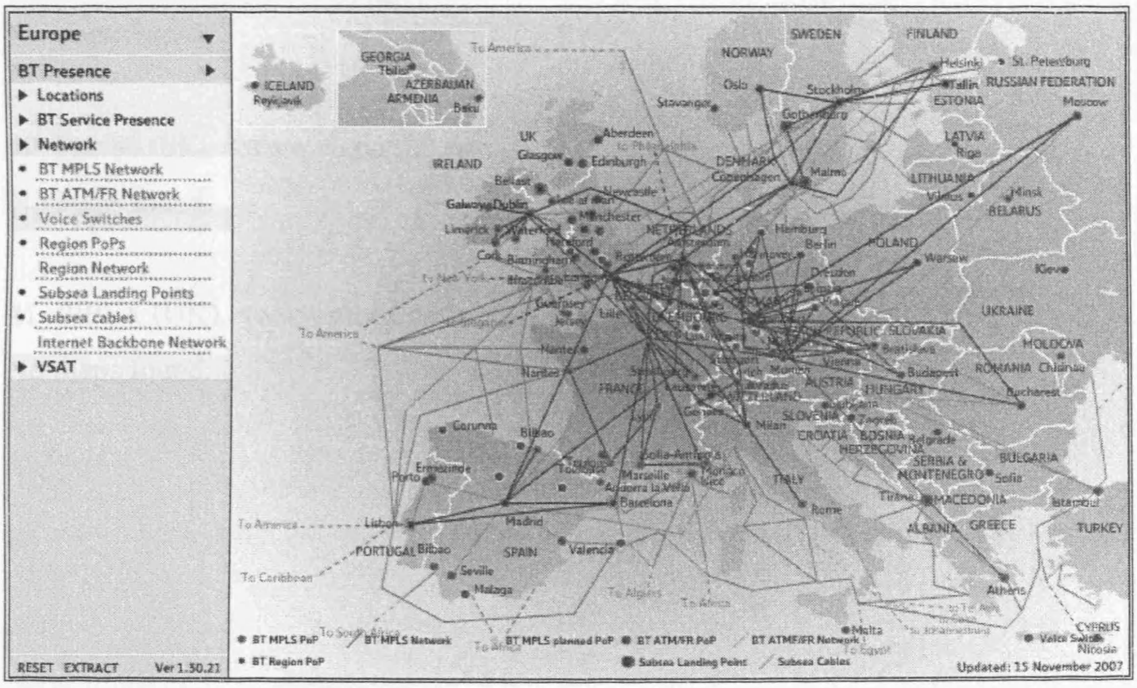
No maps found.

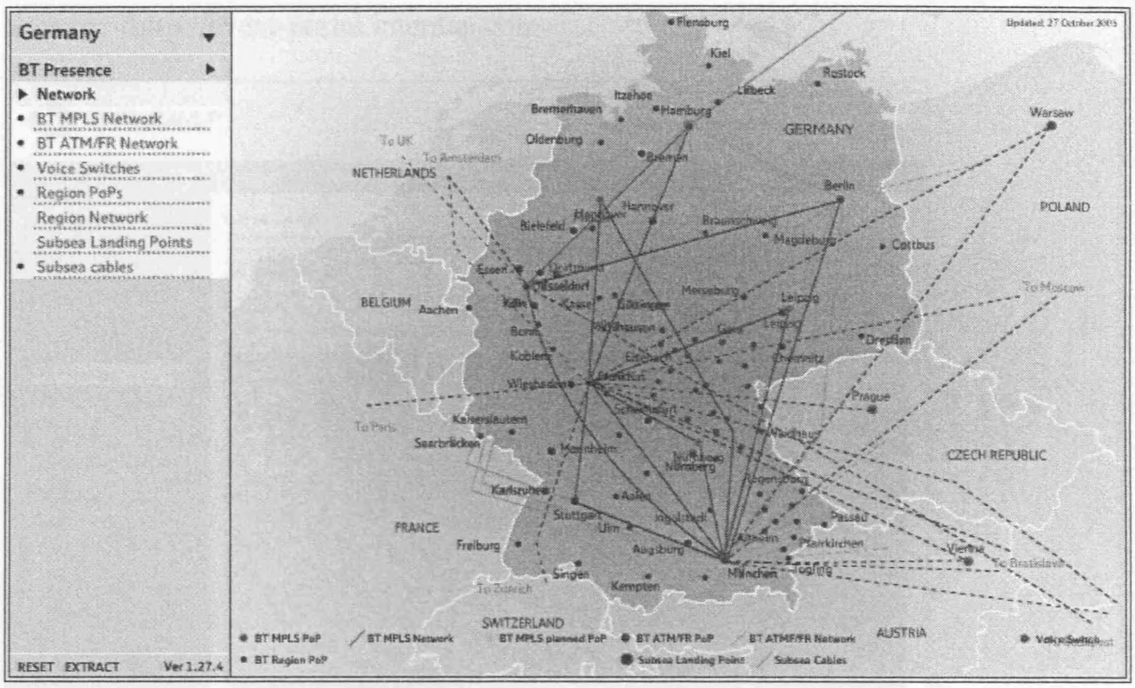
38. British Telecommunications (UK), <www.btglobalservices.com>

Source:

<www.btglobalservices.com/business/global/en/about_us/global_connectivity/>







39. REACH (HK), <www.reach.com>

No maps found.

40. Port80 (SE), <www.rixport80.se>

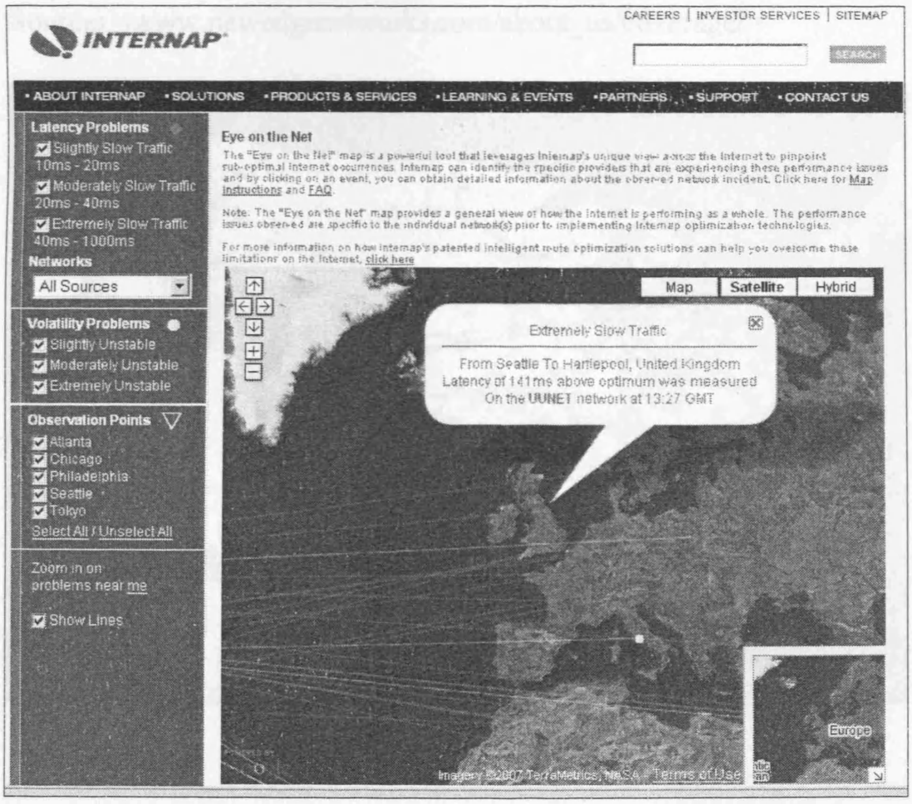
No maps found.

41. PIPEX (UK), <www.pipex.net>

No maps found.

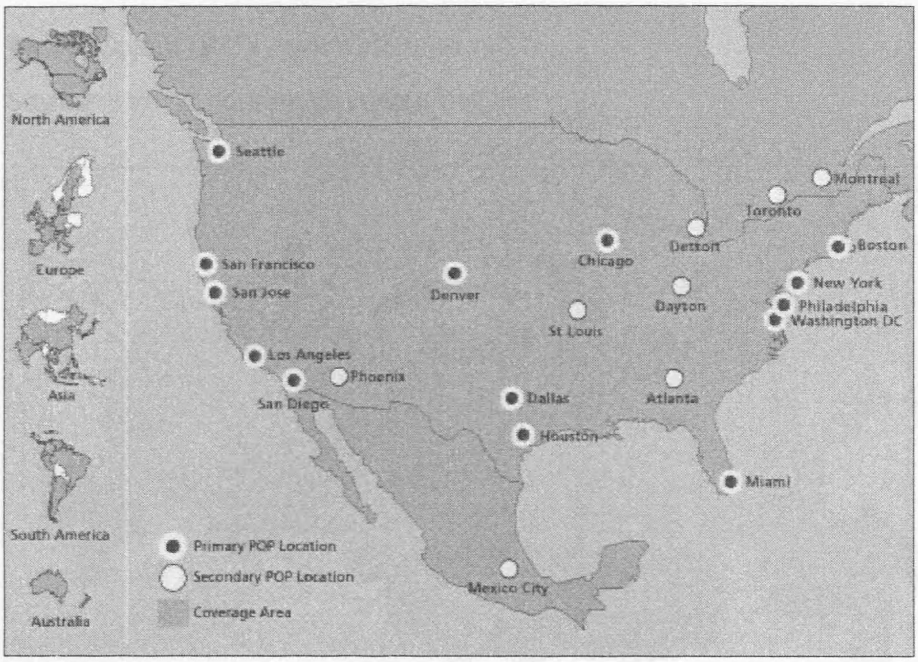
42. Internap Network Services (USA), <www.internap.com >

Source: <http://event-portal.internap.com>



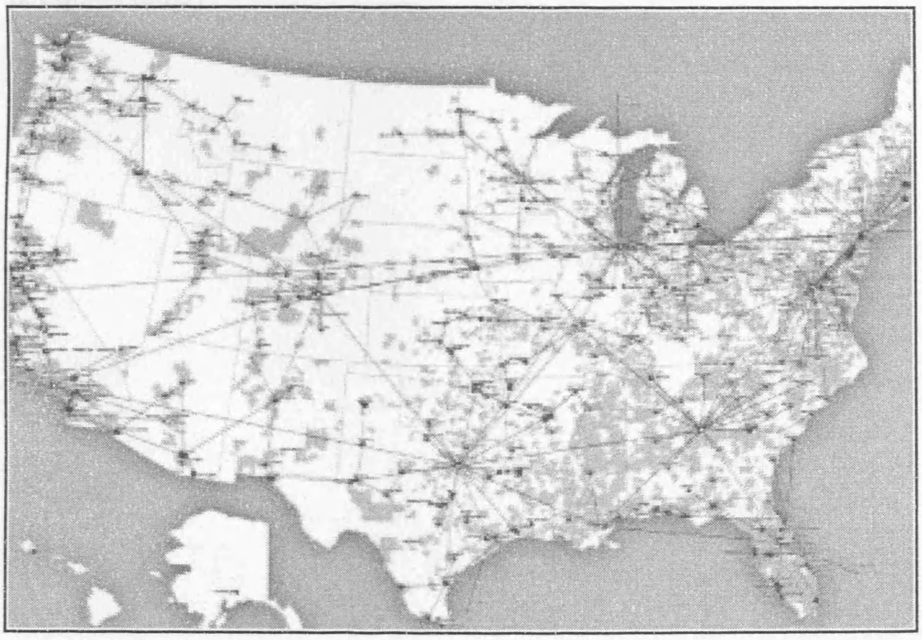
43. Yipes Communications (USA), <www.yipes.com>

Source: <www.yipes.com/technology/tech_network.shtml>



44. New Edge Networks (USA), <www.newedgenetworks.com>

Source: <www.newedgenetworks.com/about_us/coverage/>

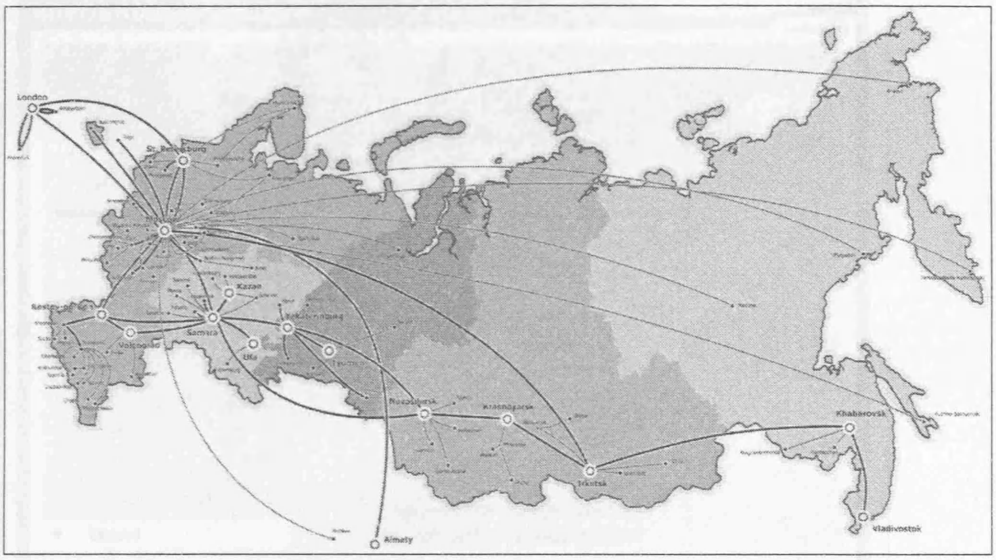


45. Romania Data Systems (RO), <www.rdsnet.ro>

No maps found.

46. RTComm (RU), <www.rtcomm.ru>

Source: <www.rtcomm.ru/en/geo/net/>



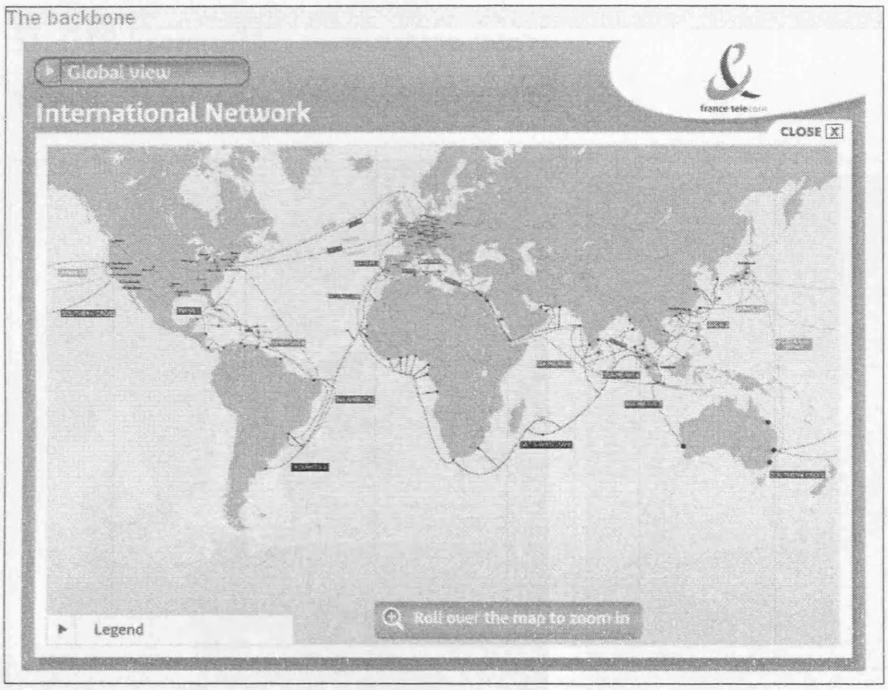
47. Cablevision (USA), <www.cablevision.com>

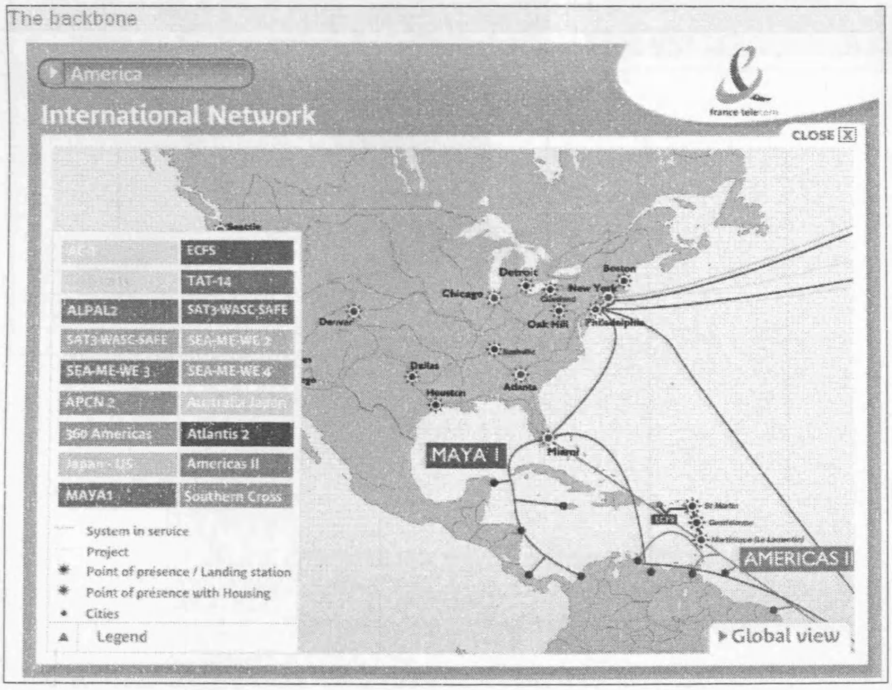
No maps found.

49. France Telecom (FR), <www.francetelecom.com>

Source:

<www.francetelecom.com/en/our_solutions/wholesalesolutions/about_us/>



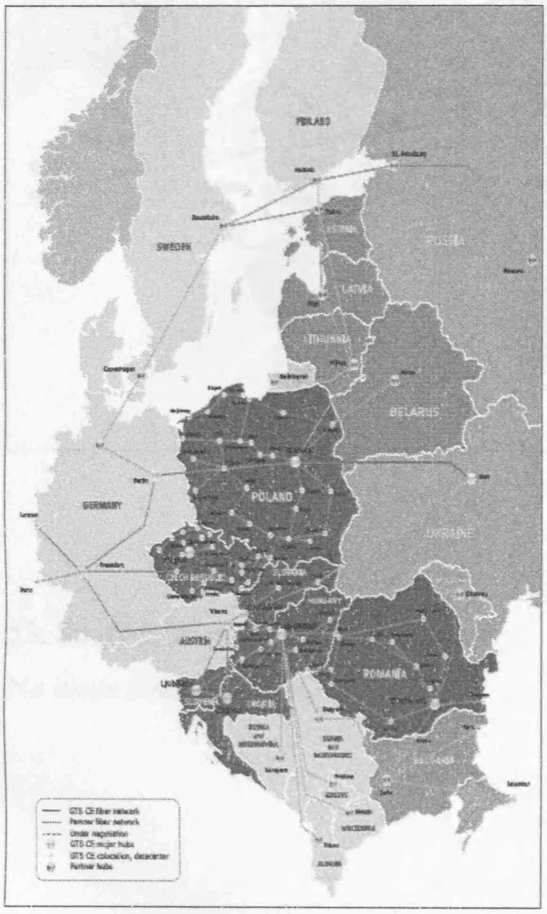


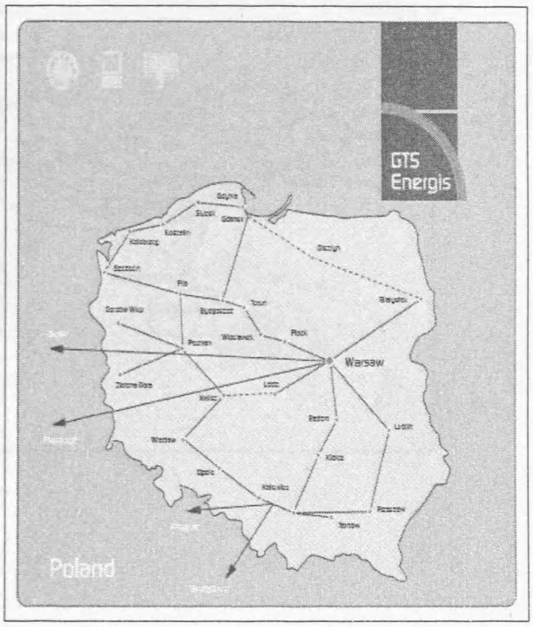
50. Cox Communications (USA), <www.cox.com>

No maps found.

51. GTS Energis (PL), <www.gtsce.com>

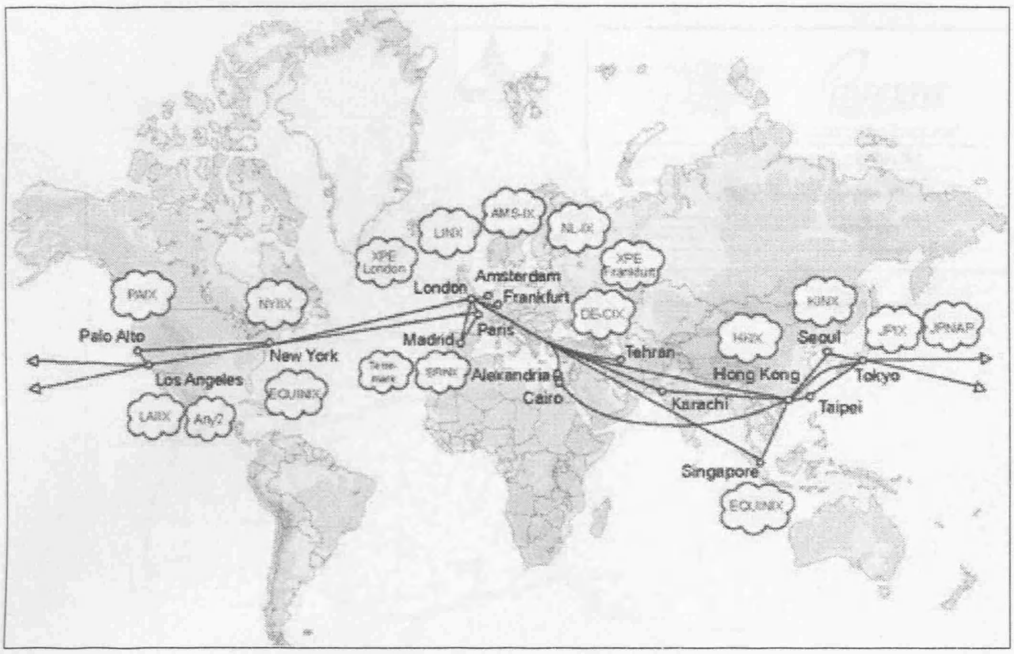
Source: <www.gtsce.com/maps/index.php>





52. Flag Telecom (UK), <www.flagtelecom.com>

Source: <www.flagtelecom.com/index.cfm?page=4024>



53. SingTel (SG), <www.singtel.com>

No maps found.

54. Integra Telecom (USA), <www.integratelecom.com>

Source: <www.integratelecom.com/about/network_and_facilities.asp>